ASSET ALLOCATION STUDY
for

Contra Costa County Employees' Retirement Association

2008

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SUMMARY

Milliman, Inc. has conducted this analysis for Contra Costa County Employees' Retirement Association. We conducted our last such analysis in 2005. We believe the asset allocation study should be conducted every three to five years. Asset allocation is one of the most important investment decisions made by institutional investors. A recent study by Ibbotson and Kaplan (2000) found that, on average, all of an individual pension fund's performance was attributable to its asset allocation target.

This asset allocation study presents a number of alternative asset mixes for CCCERA's consideration that have been developed based on our estimates of asset class returns and risks. We present several mixes that could be appropriate depending on Board risk tolerance. This report does not address allocation of sub-categories within U.S. equities, International Equities, U.S. fixed (except for the allocation to high yield and long bonds), alternatives or other asset classes. These will be addressed separately when we consider implementation procedures.

As discussed at the Board meeting in February 2008, we have modeled the asset classes in two ways for this study. The first approach models the expected return and volatility of US and International (non-US) asset classes separately (domestic equity, international equity, etc). This is the approach that we have taken in past studies. The second approach models global asset classes (global equity, global fixed income, etc). Our rationale for the global approach is that the correlations between domestic and international securities have increased significantly over the past decade. This recent high correlation suggests that we can model asset classes on a global scale, and then allocate between domestic and international securities on a market-weighted or other basis.

We find that the current mix is quite efficient, and continues to be a reasonable choice in that it – for all practical purposes – delivers the maximum return that can be attained given the risk taken. Our model delivers slightly different preferred combinations of assets for the same expected returns, but the benefits of moving are small.

There is one issue with the current mix - its expected return of 7.6% under the traditional asset class structure is 0.2% below the actuarial interest rate assumption of 7.8%. Interest rates on fixed income have declined over the past several years, and return estimates for other asset classes have declined as well. Our expected return may be slightly under-stated since our real estate estimates are for return and risk for unleveraged core real estate, not core plus or opportunistic real estate. To achieve an expected return of 7.8% requires either a slightly more aggressive asset allocation or added return from active management.

We assume that the Board would prefer to adopt an asset mix with an expected return of 7.8%. We have proposed target asset mixes under both the Traditional and Global Asset Class structures that are expected to deliver this rate of return, net of fees. Moving to either mix would involve shifting more money into alternatives and international equities while lowering the domestic equity allocation. We have a slight preference for the global approach, but we would be comfortable implementing either approach.

The Model

Our proprietary model integrates the liabilities into the asset allocation process, considering volatility of assets in combination with liabilities - Total Plan Risk - as well as standard deviations of asset returns alone. The model solves for asset mixes that provide the lowest possible Total Plan Risk for a given return. The use of the concept of Total Plan Risk results in asset mixes that best fund – and therefore move with – the Plan's liabilities.

To illustrate, an optimization based only on asset returns without consideration of liabilities would select a portfolio of 100% T-bills as the lowest risk portfolio, but T-bills are not the lowest Total Plan risk mix due to the duration mismatch between T-bills and the liabilities. (The present value of the liabilities, due to their long duration, changes dramatically with changes in interest rates, while the present value of T-bills does not, due to their short duration.) A portfolio comprised mostly of bonds with a similar duration to the liabilities - and therefore a similar sensitivity to changes in interest rates - would be a better match to the present value of the liabilities. (A dedicated portfolio of bonds with a duration matching the Liability duration of 13.9 years would result in a very low Total Plan Risk.)

The Inputs to the Model

Milliman has projected standard deviations, returns and correlations for a number of asset classes as well as the liabilities. Our projections are based on historical data, Milliman research, projections by outside sources and judgment. We evaluate the inputs as a whole to ensure their reasonableness as a set. We look at the risk-return characteristics of each asset class relative to the other asset classes as a check on our inputs and our view of the relative attractiveness of the asset classes.

To develop appropriate risks and correlations for the liabilities, we considered the Plan's projected benefit obligations for active and retired Plan members as provided by the Plan's actuary. We calculated the duration of these projected benefit payment streams. The longer the duration, the more sensitive the liabilities are to changes in interest rates. We also assessed the sensitivity of the Plan's liabilities to changes in inflation and real interest rates. Based on this analysis, we are able to predict how the liabilities will react to various changes in economic conditions. We then project the standard deviation and correlation of the liabilities with each of the proposed asset classes.

We should note that the actuarial interest rate includes 3.75% inflation component, while our estimated returns include inflation of around 3.25%.

The Output

Using our optimization program, we generated an “efficient frontier” of asset mixes. Each asset mix is optimal on a risk/reward basis, meaning that the highest expected return is achieved for any given level of risk. The asset mixes range from a low risk/low expected return mix to a high risk/high expected return mix. The lowest risk mix has the lowest funding variability due to the high correlation with the liabilities. The highest risk mix has the highest expected return but also has the greatest uncertainty in return variance and liability funding.

Selecting an Appropriate Optimal Asset Mix

All of the asset mixes on the "efficient frontier" are optimal for their particular level of risk. Other possible asset class combinations are so close to the frontier as to be essentially equivalent, and would also be suitable. The willingness and ability of CCCERA to take risks and the implications of possible mixes' funding status are the important factors in selecting the appropriate optimal asset mix. To assist in this decision, we present the sensitivity of the Plan's funded status to capital market returns. For each asset mix on the "efficient frontier," we consider the implications for achieving desired rates of return over short-term (1 year), medium-term (5 years) and a long-term (13.9 years - the liability duration) time horizons. Specifically, we focus on the following two questions:

1) What future returns, in dollar levels, are likely to be achieved by each mix, and how uncertain is that level?

2) What is the likelihood that the actuarially-assumed rate of return will be achieved for each mix?

In addition to CCCERA's willingness and ability to take risks and the implications for achieving required returns, adopting a new asset allocation target requires taking into account the Fund's current asset allocation and the costs to change. The expected cost of implementing a new asset mix must be considered relative to the expected benefit of the mix.

With the above considerations, a "Recommended" mix is suggested to facilitate the Board's selection of an appropriate optimal asset mix.

Conclusion

A case could be made why the Plan might wish to adopt any of the proposed asset mixes. Narrowed Mix 6 under both the Traditional and Global Asset Class structure is expected to deliver an expected 7.8% rate of return over the next 3-5 years. Mixes 5 and 7 under each scenario are also reasonable alternatives. The Board must determine which approach, Traditional or Global, it is more comfortable with. Under either approach, we recommend adoption of the respective Mix 6, which is expected to deliver the actuarial interest rate of 7.8%.

We conclude that the current asset mix is essentially optimal in terms of return for the risk taken. We propose the adoption of Mix 6, which is close to the current target asset allocation. Under the Traditional approach, moving to Mix 6 Traditional would decrease the domestic equity allocation by 10%, increase international equity by 7%, increase domestic fixed income by 4% (but shift 2% out of domestic core fixed income while adding 1% to high yield and 5% to long bonds. The non-US fixed income allocation comes in 2% lower. However, since this has been converted to a global mandate, the current 4% global allocation would come half from the domestic allocation and half from the international allocation. The allocation to alternative investment would rise by 3%. The real estate allocation and cash allocations would be unchanged.

Under the Global approach, moving to Mix 6 Global would reduce the global equity allocation by 5.5%, increase overall fixed income by 2% (shifting 5% out of core fixed income while adding 2% to high yield and 5% to long bonds. The real estate allocation would be increased by 0.5% and the allocation to alternative investment would rise by 3%. The cash would be unchanged.

The Current Target, Proposed and Alternative Asset Mixes are detailed below for both the Traditional and Global Asset Class approaches.

	Traditional Asset Mixes				
Component	Current Target	Alternative Mix 5	Recommended Mix 6	Alternative Mix 7	Proposed Ranges of Mix 6
Domestic Equities	43.0	33.5	33.0	33.0	30-36%
International Equities	11.5	17.0	18.5	19.5	16-21%
Domestic Bonds	23.0	20.0	21.0	19.0	18-24%
High Yield	2.0	2.0	3.0	4.0	1-3%
Long Bonds	0.0	5.0	5.0	5.0	0-6%
Intl Bonds	4.0	6.0	2.0	0.0	0-4%
Real Estate	9.0	8.0	9.0	11.0	6-10%
Alternatives	5.0	8.0	8.0	8.0	5-10%
Cash	0.5	0.5	0.5	0.5	0-1%
Return, %/yr	7.6	7.7	7.8	7.9	
Standard Deviation, %/yr	11.4	11.5	11.7	12.0	
Total Plan Risk, %/yr	19.1	18.9	19.2	19.4	

	Global Asset Mixes				
Component	Current Target	Alternative Mix 5	Recommended Mix 6	Alternative Mix 7	Proposed Ranges of Mix 6
Global Equities	54.5	48.0	49.0	49.5	45-53%
Global Fixed	29.0	28.0	24.0	20.0	20-28%
High Yield	2.0	2.5	4.0	6.0	2-6%
Long Bonds	0.0	5.0	5.0	5.0	4-6%
Real Estate	9.0	8.0	9.5	11.0	6-12%
Alternatives	5.0	8.0	8.0	8.0	5-10%
Cash	0.5	0.5	0.5	0.5	0-1%
Return, %/yr	7.7	7.7	7.8	7.9	
Standard Deviation, %/yr	12.5	12.1	12.4	12.7	
Total Plan Risk, %/yr	19.7	19.3	19.6	19.9	

LIABILITY ANALYSIS

Overview

Our analysis of the liabilities is based on projections provided by CCCERA's actuary, The Segal Company. Segal's projection of benefits to members incorporates numerous assumptions regarding future salaries, mortality rates, termination rates, disability rates, inflation, asset returns, etc. Inflation is projected at 3.75% per year by the actuary, while earnings on assets (used to discount future liabilities) is projected at 7.80% per year.

At our request, Segal projected the payments to be made to retired, inactive and current Association members related to current service and anticipated future wage growth. Benefits for future service were not considered in these liability projections, since they will be funded with future contributions invested in future assets. Keeping our focus on present members' benefits correctly matches our focus on the present assets. This does not limit the value of this study; future studies will most likely find similar member demographics and reach similar conclusions.

We estimate the volatility of the liabilities and their correlation with each of the proposed asset classes. Appropriate estimates of these variables allow us to determine asset mixes that best fund the Plan's liabilities. Total Plan Risk can be reduced by selecting assets that behave like the liabilities through fluctuations in financial markets and therefore offset the liabilities volatility.

For the baseline projection case, we have used an inflation rate of 3.75% per year, and a real return of 4.05% per year, resulting in a discount rate of 7.80%. Although the 3.75% inflation rate is above that experienced since the early 1990s, it seems possible in light of recent inflationary pressures on the US market. Over the ten years ending December 31, 2007, the US experienced inflation of 2.7% per year. We believe that this figure may trend somewhat higher in the coming years. It is interesting to note that the long-term inflation figures for the US are quite low. For the period 1926-2006, the US had annualized inflation of just 3.1%. The real return assumption of 4.05% used in our discount rate represents the expected return above inflation for a moderate-risk asset.

Analysis of Retired and Inactive System Members

Our liability analysis begins with a review of the retired and inactive (terminated vested) Association members. All promised benefits payable to this group have been accrued, so projected benefits are quite predictable. We calculate the present value of projected benefits to retired and inactive members to be $3,019.9 million, after discounting the benefits at a 7.80% annual rate.

Figure 1 below shows graphically the benefit payment projections for retired and inactive members. Actual benefits paid to current retirees increase over the next few years due to inflation, and then decline due to mortality while nominal benefits paid to inactive members peak 31 years in the future. Discounted benefits – the present value of benefits (shown in Figure 2) – decline immediately at an average rate of 11.6% per year, as the 7.8% discount rate and mortality assumptions decrease the present value of benefits, and will have fallen to half their value in roughly ten years. Some 40 years into the future, the discounted benefits to current retirees and inactive members are relatively insignificant. The average benefit is paid 10.1 years in the future.[1] This gives an indication of the sensitivity of the present value of these liabilities to changes in interest rates.

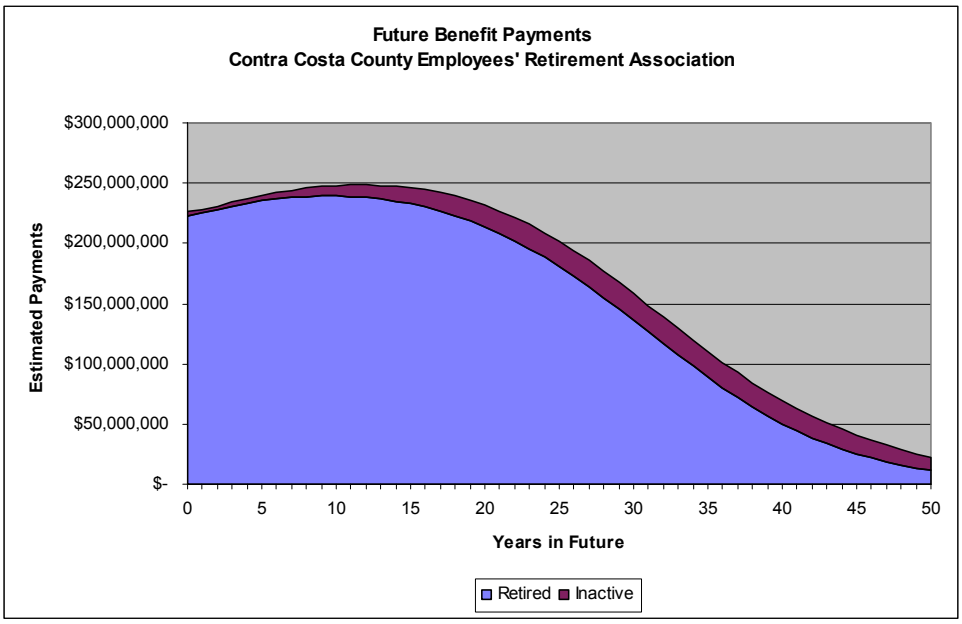


Figure 1

[1] In computing the average payment, we weight discounted payments by the number of years in the future. This is identical to the computation of a Macaulay bond duration.

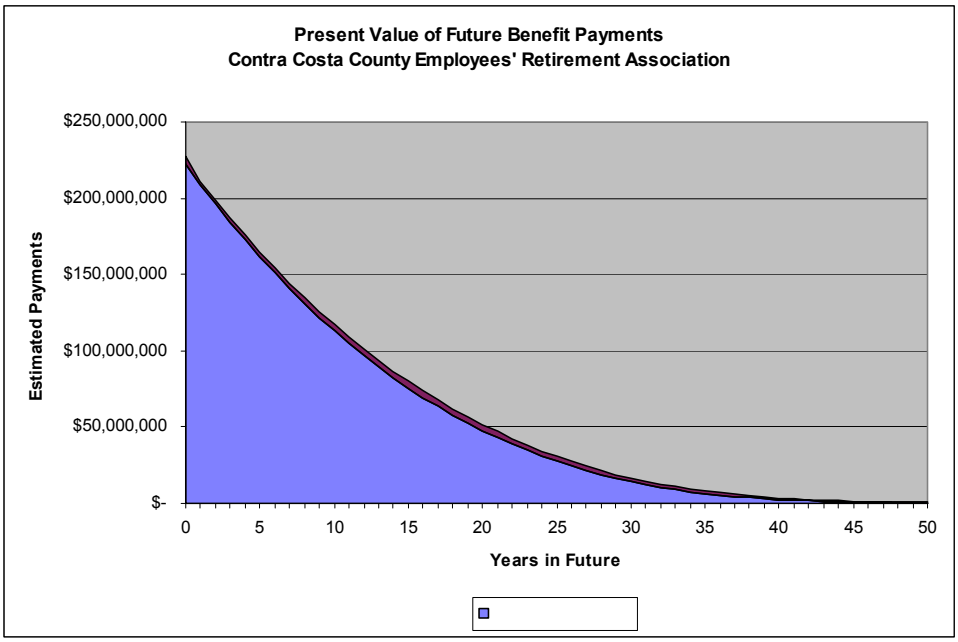


Figure 2

We have investigated the impact of a higher inflation rate of 4.75% instead of the 3.75% baseline assumption. We held the real return constant at 4.05%, so the discount rate increased from 7.80% to 8.80% in this sensitivity test. Increasing the inflation rate by 1% causes the present value of the retired and inactive members' liabilities to decrease 8.5% to $2,764.4 million.

We also investigated the impact of a higher real rate of return: increasing this rate decreases the cost of funding future payments by increasing the discount rate. By increasing the projected real rate of return from 4.05% to 5.05% per year, the discount rate rises to 8.80%. While actual payments to retirees are unchanged, this causes the present value of benefits to fall by 8.6% to $2,759.8 million, nearly the same effect as a 1% change in the inflation assumption since the cash flows to the retired and inactive members are largely determined.

Analysis of Active System Members

In contrast to retired member benefits, active members will earn a large portion of their projected benefits in the future. These future benefits can be broken down into three components:

1. Accrued service only
2. Future wage inflation
3. Future real wage growth

In the analysis below, we treat projected payments related to future service separate from wage inflation and real wage growth, which will be examined in the final analysis.

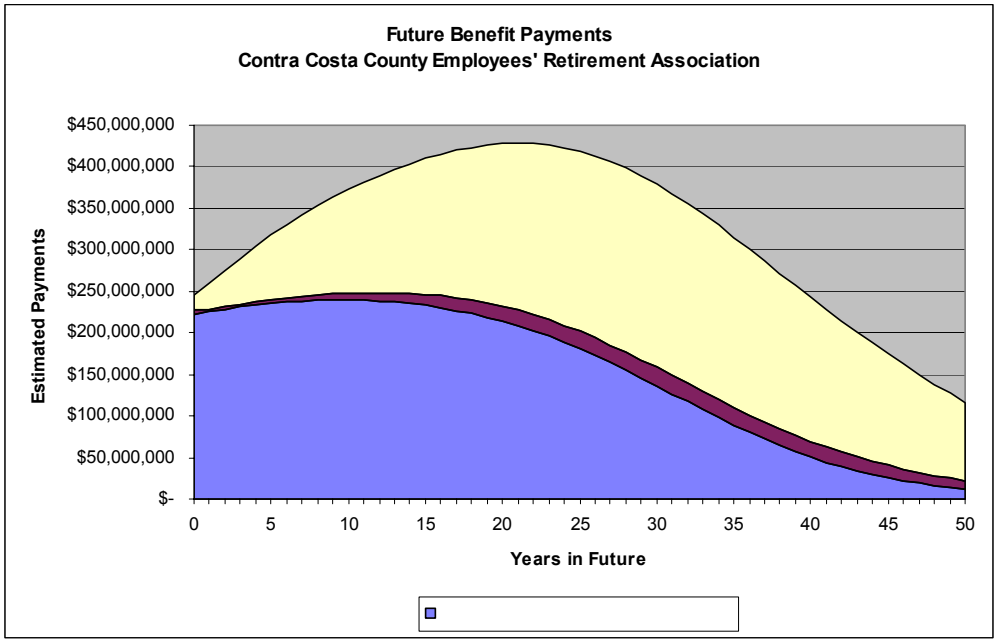


Figure 3

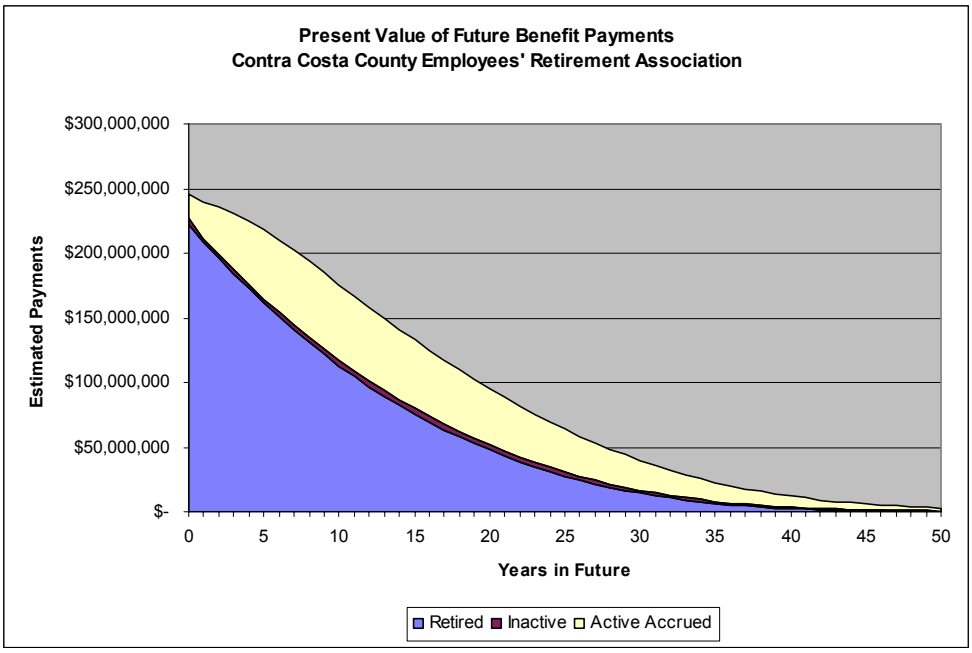


Figure 4

As with current retirees, discounting active members' liabilities shifts the impact of the distribution towards the present and reduces it substantially, since payments far in the future have a much lower present value than future value. The peak in discounted liabilities occurs 9 years in the future and these liabilities become insignificant 50 years in the future (see Figure 4 above). The present value of the estimated benefits to active members for accrued service is $1,561.6 million and the average payment (duration) occurs 17.0 years in the future.

As we did for retired and inactive members, we prepared a sensitivity analysis for active members considering changes in inflation and the real rate of return. We increased the inflation assumption by 1%, from 3.75% to 4.75%. Higher inflation increases final salaries – and therefore, benefits – due to the higher salary growth over many years. However, to maintain a constant "real" rate of return the discount rate is also increased, which decreases the present value of the benefits. Our higher-inflation scenario resulted in a present value of $1,345.2 million, 13.9% lower than the baseline assumption. The increases resulting from higher inflation are more than offset by the decreases resulting from the higher discount rate, so the benefits become less expensive to fund.

Changes in real returns have a somewhat greater impact than changes in the inflation rate: if we increase the assumed real rate of return from 4.05% to 5.05% while maintaining our 3.75% inflation assumption, the liabilities' present value decreases 14.1% to $1,341.3 million. Because inflation is constant instead of increasing, future salaries are not higher; while the discount rate increases due to the change in the real rate of return.

Analysis of All Members — Retired, Inactive, Active and Future Growth

Including the second and third components of active member liabilities (future wage inflation and future real wage growth) with the total liabilities gives the projections a stronger forward-looking perspective. By combining all three measurements, we calculate that the liabilities of the active employees have a present value of $2,350.0 million and a calculated duration of 18.8 years.

Finally, combining the projected payments to retired and inactive members with the projected payments to active members for accrued and future service, future wage inflation and future real wage growth, all members' benefits have an estimated present value of $5,369.8 million (discounted by the 7.8% baseline assumption), with a calculated duration of 13.9 years.

Member	Present Value	Duration (Years)
Current Retirees	$2,888.8 mm	9.7
Inactive Members	$131.1 mm	18.6
Active (Accrued)	$1,561.6 mm	17.0
Active (Inflation)	$662.4 mm	22.1
Active (Growth)	$126.0 mm	24.1
Total	$5,369.8 mm	13.9

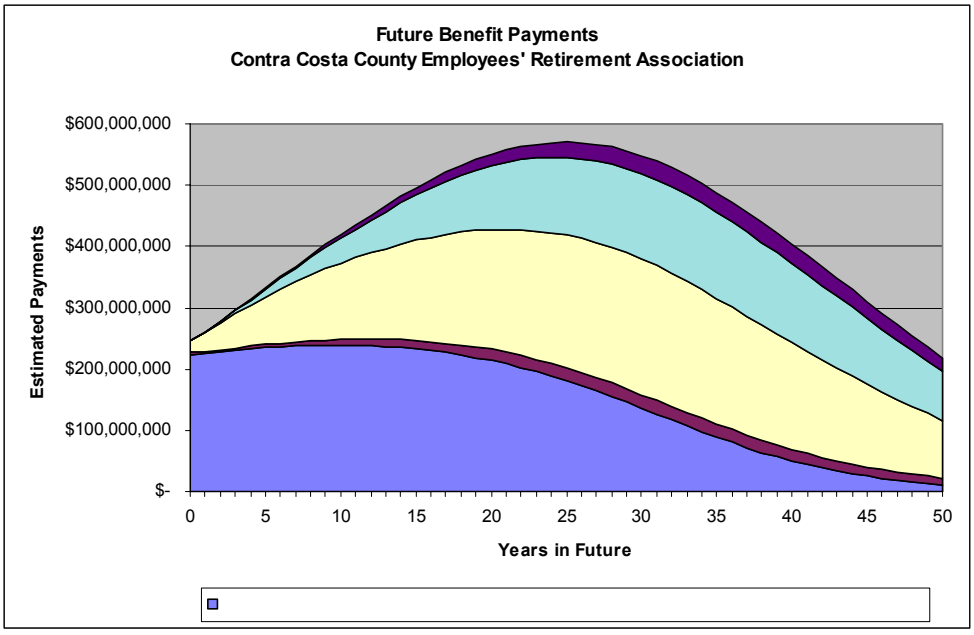


Figure 5

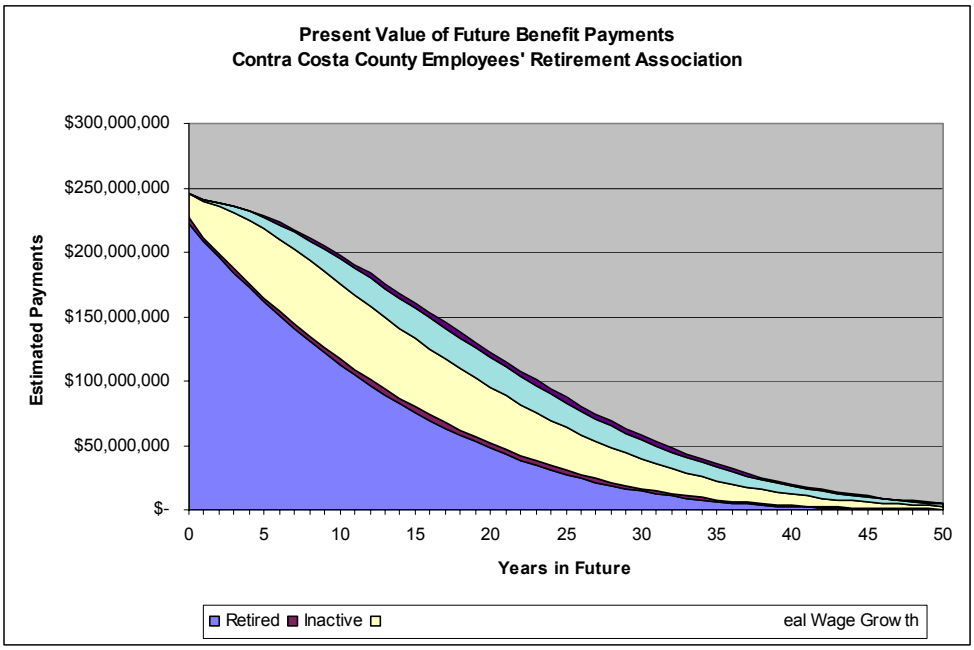


Figure 6

The long duration of the Plan's liabilities makes them highly sensitive to changes in the inflation rate and real rate of return. Absent a change in expected real returns, a 1% increase in the inflation assumption decreases the present value of liabilities to $4,884.3 million, a 9.0% decrease. Increasing the real return assumption from 4.05% to 5.05% without an offsetting change in inflation decreases the present value of liabilities by 11.6% to $5,369.8 million.

Funding Ratio Implications

In our analysis, we consider the funding ratio – the value of the liabilities relative to the assets. When liabilities are larger than assets, the assets must move more than the liabilities in market value to maintain the same dollar funded status. For example, if liabilities are $100 and assets are $80 and the liabilities increase 10% to $110, the assets must increase 12.5% to $90 to maintain the same $20 under-funded status; the same is true for negative returns.

The Plan's assets as of December 31, 2007 were $5,236.4 million, less than the projected present value of the liabilities of $5,369.8 million. We adjusted the liability volatility estimate upward to reflect this ratio. Please note that this funding ratio is not the same as the one reported by the Association's actuary.

Liabilities Summary

We undertook a review of the Plan's liabilities to consider the time-horizon of payments and the sensitivity of the liabilities to factors that can also cause asset values to vary.

Payments to all current members are expected to be paid on average 13.9 years into the future (on a discounted present value basis). These payments have characteristics similar to a long-term bond. This 13.9 year duration indicates that the value of the Plan's liabilities is exposed to substantial volatility from changes in the assumed discount rate: a 1% increase in inflation causes a decrease of 9.0% in the liabilities' present value, while a 1% increase in the real return causes a more substantial decrease of 11.6% in the value of the liabilities.

The liability characteristics developed in this section are used in the following section to develop the relationship of the liabilities with the asset classes.

Comparison to Prior Studies

Liabilities	**Retired and Inactive Members**		**Active Members**		**Combined Members**	
	Present Value	Duration	Present Value	Duration	Present Value	Duration
1997	$890 mm	9.7	$787 mm	18.9	$1,677 mm	14.0
2000	$1,231 mm	10.0	$1,162 mm	19.2	$2,393 mm	14.4
2005	$2,212 mm	9.7	$2,044 mm	19.2	$4,256 mm	14.3
2008	$3,020 mm	10.1	$2,350 mm	18.8	$5,370 mm	13.9

ASSET ALLOCATION ALTERNATIVES

Introduction

If it were possible to create an asset mix that matched the liabilities there would be no uncertainty about funding – the Plan could project future funding ratios exactly, based on contribution levels. It is possible to build a dedicated bond portfolio that would fund projected benefit payments closely. We do not believe the Plan should pursue this "riskless" goal, for the following reasons:

- No asset or combination of assets match the sensitivity of Plan liabilities exactly because projected benefits are only estimates subject to revision. A bond portfolio with a 13.9 year duration would come closest to our low risk Mix 1, but using such a portfolio would concentrate the Plan in a small fraction of available investment-grade assets.
- By selecting assets such as equities or alternative assets that exhibit other patterns of return variability, the Plan may be able to get a much higher return from its assets. This may be preferred to a less volatile, lower-return mix.
- Liability matching is not the only goal of asset allocation. Absolute rates of return and performance compared to peers are also considerations. Very long duration bond portfolios exhibit high absolute volatility that could prove damaging to a fund in the short-term even though matching the liabilities.

For these reasons we use both the total bond market and long duration bonds in this study, but focus on the total bond market when discussing the opportunity set.

In this section we construct asset mixes that are optimal – the highest expected return for a given amount of uncertainty – while considering inflation and other sources of uncertainty. The lowest-risk mix most closely matches the characteristics of the liabilities and thus has the lowest Total Plan Risk; higher-return mixes show greater uncertainty.

Asset Categories

The asset/liability approach used in this analysis is best suited for comparing broad asset classes, while other approaches are more appropriate for fine-tuning classes (e.g., for allocating domestic equities between large- and small-capitalization issues or allocating domestic fixed income between mortgages and corporate issues).

When we briefed the Board on our approach to the asset allocation study earlier this year, we stated that we could present a study using primarily the existing asset classes or that we could conduct a study using global asset classes and treat the US / international mix as a second decision. After some discussion with the Board, we concluded that we should run the study both ways and present the data to the Board for discussion.

In the first approach, we include the asset classes already in the CCCERA portfolio and add treasury inflation protected securities (TIPS) and long-duration fixed income. In the second scenario, we aggregate all equities and also investment grade fixed income into global asset classes.

APPROACH 1: TRADITIONAL ASSET CLASSES

To study the asset categories selected, we chose a representative index for each that both captures the characteristics of the category and is well-defined:

(1) Domestic Equities (Russell 3000® Index);
(2) International Equities (MSCI EAFE Index);
(3) Domestic Fixed Income (Lehman Universal Bond Index);
(4) Domestic High Yield Fixed Income (Merrill Lynch High Yield II Index);
(5) Domestic TIPS (Lehman U.S. TIPS Index);
(6) Domestic Long Duration (Lehman Long Government/Credit Index);
(7) International Fixed Income (JP Morgan Non-US Bond Index);
(8) Real Estate (NCREIF Property Index);
(9) Commodities (Dow Jones AIG Commodity Index);
(10) Alternative Investments (UBS Private Equity Performance Indicator);
(11) Cash and Equivalents (91-day Treasury Bills); and
(12) Plan Liabilities as developed in the *Liability Analysis* section of this report, shown as a "negative asset" that other assets serve to offset.

Expected Returns and Uncertainty

Our model uses the expected annual return and the uncertainty of returns (standard deviation) for each asset class. Below are our projections for each asset class:

Asset Class	Return	Std Dev
Domestic Equities	8.60%	18.00%
International Equities	8.90	20.00
Domestic Fixed Income	5.00	5.00
High Yield Fixed Income	6.50	9.00
TIPS	4.60	4.00
Long Duration Fixed Income	6.00	8.00
International Fixed Income	4.70	8.00
Real Estate	7.10	12.00
Commodities	6.00	16.50
Alternative Investments	12.75	30.00
Cash	3.00	1.25
Liabilities	n/a	20.07[2]

[2] $LiabilityVolatility = \left(\frac{LiabilityDuration}{BondMarketDuration}\right) \times \left(BondVolatility\right) \times \left(\frac{PlanLiabilities}{PlanAssets}\right)$

Derivation of the asset classes' expected return and risk estimates are described in the *Appendix A - Basis for Capital Market Assumptions*. The liabilities' uncertainty was derived from their characteristics, primarily, the sensitivity of benefit payments to changes in interest rates (duration). The standard deviations for real estate and alternative investments reflect our estimate of the underlying variability of the asset classes, and are higher than the appraisal-based values sometimes used.

The projections reflect our assessment of returns and risks over the next five years, and we believe also approximate how investors in aggregate would expect these assets to perform.

Correlations

The following "correlation matrix" indicates the extent to which we project an increase in the value of one asset class will match an increase in the value of another. For example, the boldface **"0.75%"** shows that roughly 75% of increases or decreases in domestic stock returns correspond to similar moves in international stocks.

	Dom Eq	Int'l Eq	Dom Bonds	High Yield	TIPS	Long Bonds	Intl Bonds	Real Estate	Comm	Alts	Cash	Liabilities
Dom Eq	****											
Int'l Eq	0.75	****										
Dom Bonds	0.20	0.18	****									
High Yield	0.50	0.40	0.20	****								
TIPS	-0.06	-0.08	0.68	0.24	****							
Long Bonds	0.21	0.18	0.90	0.40	0.70	****						
Intl Bonds	0.10	0.37	0.75	0.31	0.40	0.70	****					
Real Estate	0.30	0.30	0.20	0.39	0.05	0.28	0.28	****				
Commodities	-0.16	-0.07	-0.09	-0.16	0.03	-0.14	0.06	-0.07	****			
Alternatives	0.60	0.50	0.10	0.41	-0.07	0.13	0.13	0.57	-0.08	****		
Cash	0.00	-0.05	0.28	0.13	0.25	0.17	0.05	0.02	-0.07	0.00	****	
Liabilities	0.27	0.22	0.94	0.34	0.64	0.96	0.75	0.18	-0.20	0.06	0.10	****

The correlations used in this projection are close to their recent historical values as shown in *Appendix A – Basis for Capital Market Assumptions*. Correlations to the liabilities are derived by analyzing the sensitivities in the previous section.

Since the present value of pension liabilities is determined most importantly by interest rates, the correlation of long-duration bonds to liabilities is high: 96%. Equities' values are more sensitive to the changes in perceived "real" returns. Some of equities' volatility is also due to changing interest rates, as shown by their correlation to bonds. Additionally, equities' returns significantly depend on investor perceptions of future economic growth, which have limited impact on our liability computations. International equities have positive correlation to the liabilities through their similarity to domestic equity returns.

Real estate correlates to the liabilities through its sensitivity to interest rates and its correlation to bonds. Alternative investments (primarily private equity in this analysis) are quite different from traditional asset classes and the liabilities. They have a fairly high correlation with equities but are virtually uncorrelated with the liabilities. T-Bills (cash) are correlated to the liabilities through their correlation to bonds.

Constraints

Some asset classes were constrained to limit consideration to reasonable mixes; this did not unduly restrict choices. Long-duration fixed income was constrained to 5% of assets (we generally restrict new asset classes to a relatively low allocation until the Board becomes comfortable with the investment) and alternative investments were constrained to 8% of assets (to prevent a 100% alternative investment option as the highest return option). Also, a minimum of 0.5% was specified for short term fixed income. Cash and equivalents are undesirable investments for a long-term liability stream, but some cash-on-hand is necessary in the course of operations. We advise reducing cash as much as possible.

Optimal Asset Mixes for Given Risk Levels - Broad Asset Mix, Traditional Asset Classes

	Limits		*Asset Mix Alternatives*										Current
Component	min	max	*I*	*II*	*III*	*IV*	*V*	***VI***	***VII***	***VIII***	*IX*	*X*	Target
Domestic Eq	0	100	5.0	17.5	25.5	28.0	34.0	**34.5**	**33.0**	**36.0**	44.5	0.0	43.0
Int'l Eq	0	100	0.0	0.0	0.0	0.0	2.5	**11.0**	**18.0**	**22.0**	32.0	91.5	11.5
Domestic Bonds	0	100	15.5	11.0	8.0	9.0	10.0	**17.0**	**20.5**	**6.0**	0.0	0.0	23.0
High Yield	0	100	0.0	0.0	0.0	0.0	0.0	**0.0**	**3.0**	**6.5**	5.0	0.0	2.0
TIPS	0	100	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	**0.0**	0.0	0.0	0.0
Long Bonds	0	5	5.0	5.0	5.0	5.0	5.0	**5.0**	**5.0**	**5.0**	0.0	0.0	0.0
Intl Bonds	0	100	74.0	66.0	59.0	51.0	40.0	**21.0**	**3.0**	**0.0**	0.0	0.0	4.0
Real Estate	0	100	0.0	0.0	0.0	0.0	0.0	**3.0**	**9.0**	**16.0**	10.0	0.0	9.0
Commodities	0	100	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	**0.0**	0.0	0.0	2.0
Alternatives	0	8	0.0	0.0	2.0	6.5	8.0	**8.0**	**8.0**	**8.0**	8.0	8.0	5.0
Cash	0.5	100	0.5	0.5	0.5	0.5	0.5	**0.5**	**0.5**	**0.5**	0.5	0.5	0.5
Return, %/yr			5.0	5.5	5.9	6.4	6.9	**7.3**	**7.8**	**8.3**	8.7	9.2	7.6
Standard Deviation, %/yr			7.0	7.1	7.7	8.5	9.6	**10.7**	**11.7**	**13.2**	15.6	19.6	11.4
Total Plan Risk, %/yr			14.8	15.0	15.5	16.1	17.0	**18.0**	**19.1**	**20.3**	21.8	24.9	19.1

Mixes I–X in this table make up the range of optimal portfolio mixes excluding emerging markets, the "efficient frontier." (We use Roman Numerals to differentiate these mixes from the narrower set of mixes that follows.) Mixes VI, VII and VIII, shown in bold, will be the focus of analysis in the next section of the report. Each of the ten mixes offers the highest possible expected return given the limits for a given level of fund uncertainty – Total Plan Risk.

Our model did not recommend allocations to Treasury inflation protected securities (TIPS) or commodities. This is in part due to lower expected returns on these asset classes in light of their recent strong performance records.

The mixes range from Mix I, the most conservative (lowest risk, lowest expected return) to Mix X, the most aggressive (highest risk, highest expected return). The least-uncertain asset mix, Mix I, is over 94% bonds, whose characteristics most closely resemble the liabilities; the highest-return mix is comprised of the maximum amounts within the constraints for alternative investments with the remainder in international equities. The most uncertain mix, Mix X, has substantially more uncertainty in future funding costs, but 3.7% per year higher expected return than Mix I. Higher-numbered mixes show diminishing extra returns for each additional unit of uncertainty.

Even Mix I, the lowest-uncertainty mix, shows 14.8% per year Total Plan Risk, because the Plan liabilities are much more volatile – due to their long duration – than the best-match asset mix. This duration variability can be understood by considering what would occur if interest rates suddenly declined 1% from current levels, with no change in inflation. One would expect a core bond portfolio to increase in value, perhaps 5%, and maybe expect a rally in the equities market. The present value of liabilities would increase about 14%, due to their higher sensitivity (longer duration). With a reduced actuarial discount rate, the Plan would become less well funded despite healthy increases in the value of its investment portfolio. Whatever change in rates actually occurs, its impact will be magnified by the greater duration of the liabilities compared to that of the assets.

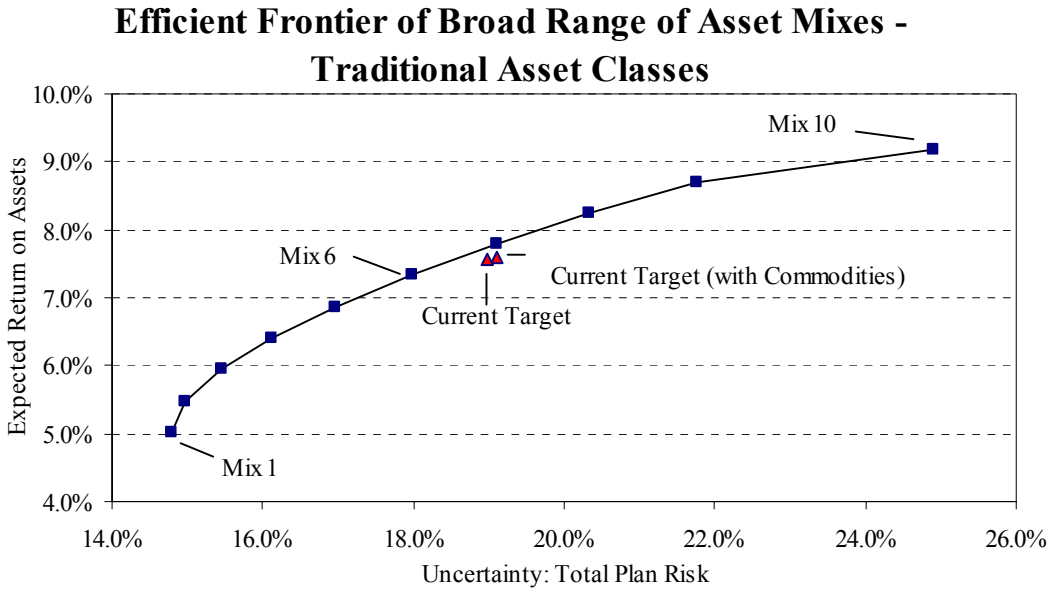


Figure 7

In Figure 7, the 10 "optimal" asset mixes are displayed on a risk/return graph, together with the current target (with and without commodities). Note that the e current target is essentially on the efficient frontier.

While the output of our model specifies ten optimal assets mixes, there are virtually an infinite number of efficient asset mixes. Between each risk-reward point in the above table there are many slightly different efficient risk/reward asset mix portfolios. Because the mixes I through V, and IX through X seem inappropriate, we derived additional efficient mixes within the range of mixes VI through VIII. The results are shown below:

Optimal Asset Mixes for Given Risk Levels:
Narrowed Risk/Reward Range, Traditional Asset Mixes

	Limits		*Asset Mix Alternatives*										
Component	min	max	*1*	*2*	*3*	*4*	***5***	***6***	*7*	*8*	*9*	*10*	Target
Domestic Eq	0	100	34.5	34.5	34.0	34.0	**33.5**	**33.0**	**33.0**	34.0	35.0	36.0	43.0
Int'l Eq	0	100	11.0	12.0	14.0	15.5	**17.0**	**18.5**	**19.5**	20.0	21.0	21.5	11.5
Domestic Bonds	0	100	17.0	18.0	18.5	19.0	**20.0**	**21.0**	**19.0**	15.0	12.0	8.0	23.0
High Yield	0	100	0.0	0.0	0.0	1.0	**2.0**	**3.0**	**4.0**	4.5	5.0	6.0	2.0
TIPS	0	100	0.0	0.0	0.0	0.0	**0.0**	**0.0**	**0.0**	0.0	0.0	0.0	0.0
Long Bonds	0	5	5.0	5.0	5.0	5.0	**5.0**	**5.0**	**5.0**	5.0	5.0	5.0	0.0
Intl Bonds	0	100	22.0	18.0	15.0	10.0	**6.0**	**2.0**	**0.0**	0.0	0.0	0.0	4.0
Real Estate	0	100	2.0	4.0	5.0	7.0	**8.0**	**9.0**	**11.0**	12.0	13.5	15.0	9.0
Commodities	0	100	0.0	0.0	0.0	0.0	**0.0**	**0.0**	**0.0**	0.0	0.0	0.0	2.0
Alternatives	0	8	8.0	8.0	8.0	8.0	**8.0**	**8.0**	**8.0**	8.0	8.0	8.0	5.0
Cash	0.5	100	0.5	0.5	0.5	0.5	**0.5**	**0.5**	**0.5**	0.5	0.5	0.5	0.5
Return, %/yr			7.3	7.4	7.5	7.6	**7.7**	**7.8**	**7.9**	8.0	8.1	8.2	7.6
Standard Deviation, %/yr			10.6	10.8	11.1	11.3	**11.5**	**11.7**	**12.0**	12.4	12.7	13.0	11.4
Total Plan Risk, %/yr			17.9	18.2	18.4	18.7	**18.9**	**19.2**	**19.4**	19.7	19.9	20.2	19.1

Within this more narrowed view of asset mix alternatives, Mix 1, which is the lowest expected return-lowest risk mix, has an expected return of 7.3% and a funding uncertainty of 17.9%. This mix has an expected return well below CCCERA's actuarial interest rate. The highest expected return-highest risk mix has an expected return of 8.2% (exceeding the actuarial interest rate) and a net funding risk level of 20.2%. This mix, #10, has more uncertainty in satisfying future funding requirements, but 0.9% per year higher expected return than Mix #1. These asset mix alternatives in the narrowed asset mix table provide more appropriate options for CCCERA, given the return objectives described above, the risk tolerance implied by the current asset mix target, and the risk/return posture of the actual current asset mix of the Association. (We should note that the actuarial interest rate includes 3.75% inflation, while our estimated returns include inflation of around 3.25%.)

There is a broad range of mixes that are essentially equivalent to the mixes above that also are perfectly acceptable alternatives. (Note that the current mix is one.)

In Figure 5 on the next page, the 10 narrowed "optimal" asset mixes are displayed on a risk/ return graph, together with the current target. We will focus on Mixes 5, 6 and 7, as well as the current target in the next section of the report.

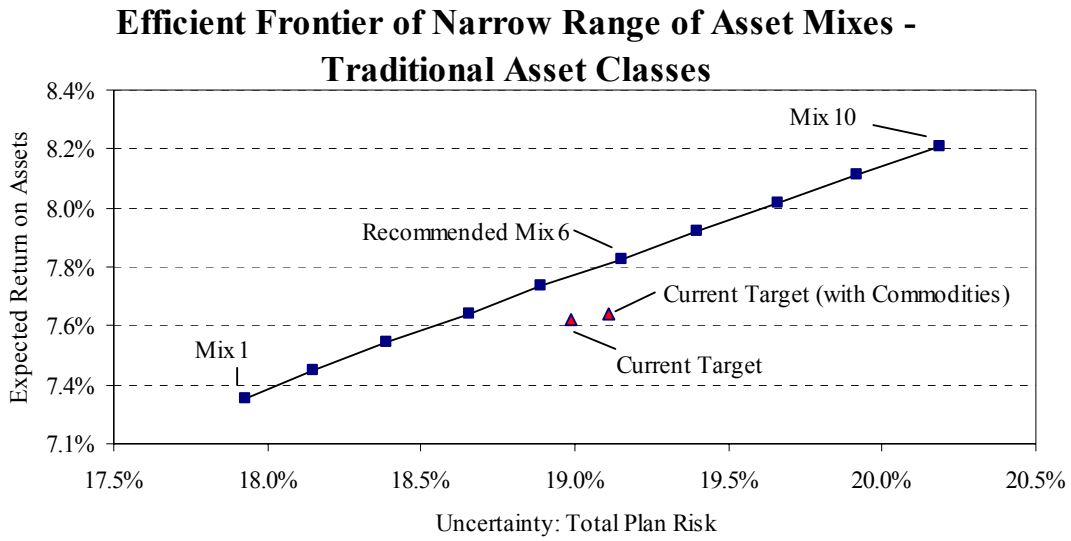


Figure 8

Asset Allocation Summary

Using the expected return, risk and correlation numbers developed in this section, we identified the efficient frontier for CCCERA, taking into account Plan liabilities. We determined that the current target mix of the Plan is essentially "optimal", offering the maximum expected return given their level of uncertainty versus the liabilities. We presented a number of other possible mixes for CCCERA consideration.

Any investment choice has inherent uncertainty about its future performance. In the next section of this report, we consider trade-off between the returns and uncertainty.

IMPLICATIONS FOR ACHIEVING THE ACTUARIAL INTEREST RATE - TRADITIONAL ASSET CLASSES

The prior section presented alternate asset mix choices. This section considers how the choice of one of those mixes will impact Plan achievement of target returns. As of December 31, 2007, Plan assets had a market value of approximately $5,237 million, roughly 3% less than the present value of Plan liabilities.

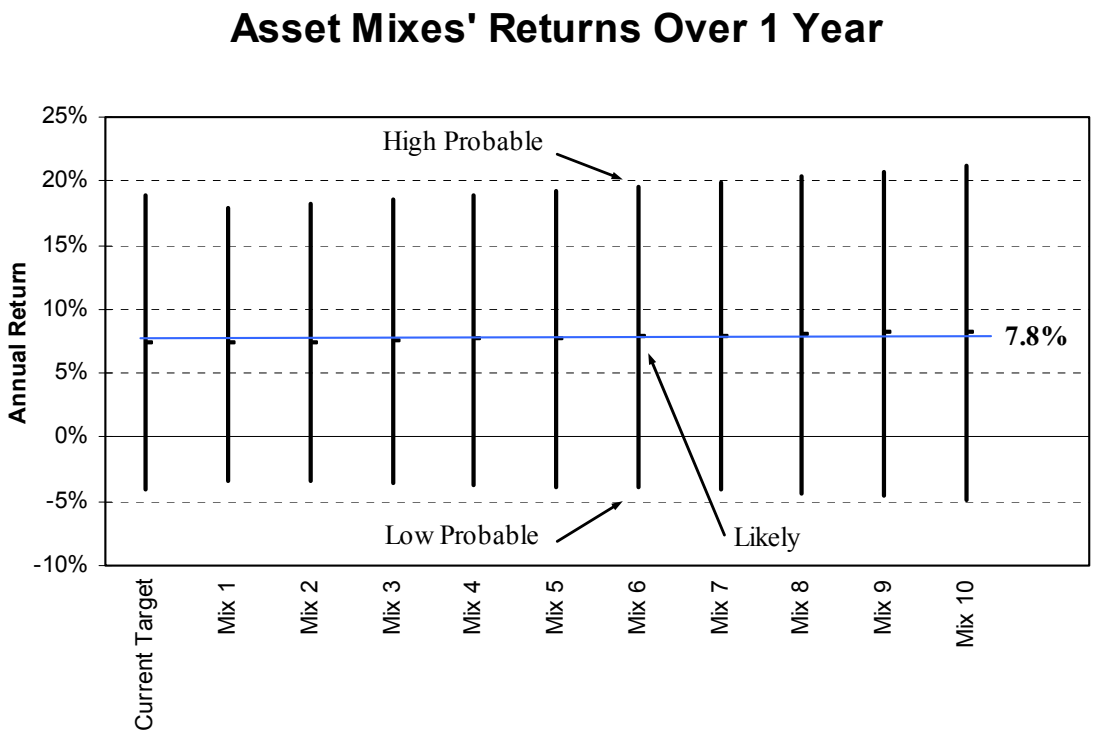


Figure 9

Figure 8 on page 19 showed the annual expected return and the estimated Total Plan Risk for each of the ten efficient mixes. In Figure 9, above, we focus on the narrowed range of mixes and the current target mix. We look at the volatility (standard deviation) of each portfolio, and estimate the probability of the portfolio exceeding the 7.8% target rate of return.

As an example, let us consider Mix 6. Mix 6 has an expected return of 7.8% per year, with a portfolio standard deviation of 11.7% per year. This mix is represented by the vertical line above "Mix 6". The dash through the middle of the vertical line, labeled with the arrow marked "Likely," is, at 7.8%, depicting the mix's expected return. The length of the vertical line is twice the mix's standard deviation. The "High Probable" arrow points to the upper boundary of the confidence interval, at 19.5% (7.8% + 11.7%), while the "Low Probable" arrow points to the lower boundary of the confidence interval, at -3.9% (7.8 - 11.7%). Roughly two-thirds of the time, returns will be below 19.5% and above -3.9%.

The total fund return in any given year has a 68% probability of falling within the one standard deviation confidence interval. The return is expected to be above the "High Probable" return approximately one year in six; returns might be lower than the "Low Probable" return just as often. Although no "absolute worst case" can be defined, a range roughly twice the size of the indicated confidence range would cover more than 95% of the likely outcomes; 2½% of any outcomes would result in a lower return and 2½% would be even more favorable.

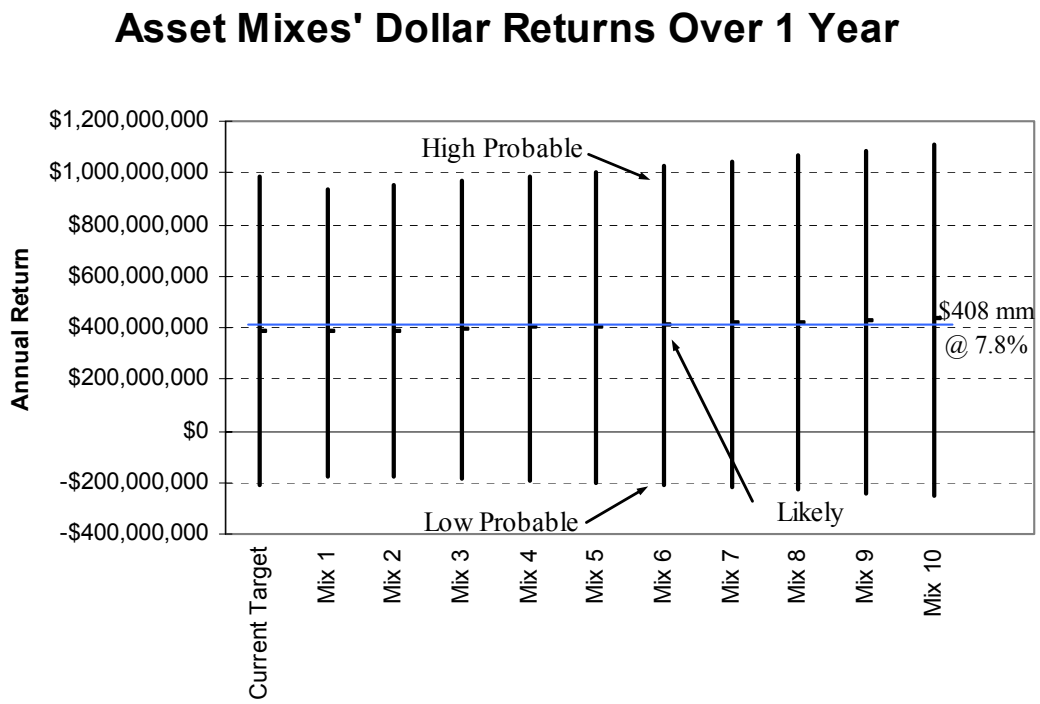


Figure 10

While we are accustomed to considering investment returns in percentage terms, we also present the information from the previous chart in dollar terms. The return target of 7.8% becomes a dollar return target of approximately $408 million on the $5.2 billion in assets. Figure 10 translates the data from Figure 9 into dollar terms.

Longer-term Perspective

We also examine the expected returns and variance of returns over a five year time period. As shown in the Figure 11 below, the expected range of returns is narrower than the range in over the one year period. The expected return of each mix has a slightly higher probability of achieving the actuarial rate of return over the five year period versus the one year period.

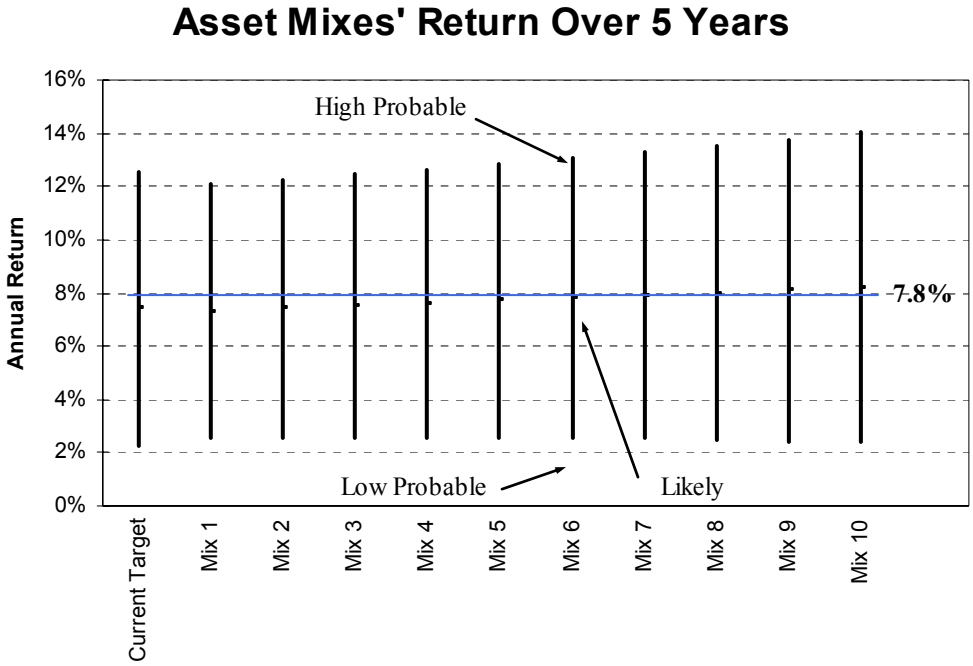


Figure 11

We also examine the expected returns and variance of returns over a longer time period. We believe that the appropriate policy frame is the time until the average liability is paid off – the "duration" of the liabilities. We recommend this planning horizon since it corresponds to actual benefits, rather than either the quarter-by-quarter perspective of the capital markets or the actuary's long-term perspective. In the liability section of this report, we reported its estimated value at 13.9 years. Looking at the longer horizon smoothes out short-term fluctuations.

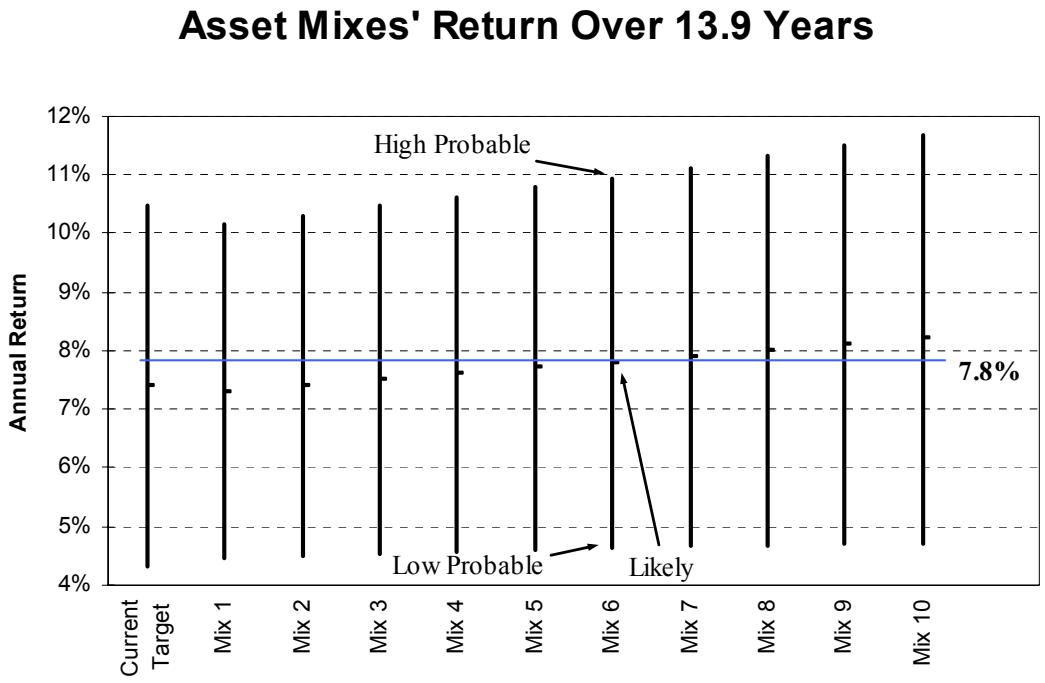


Figure 12

Figure 12 shows how the expected range of return narrows when variability is spread over the 13.9 year liability horizon. The uncertainties appear substantially "tamed" (although on a dollar basis volatility increases with time). Taking the longer view to risk makes the more aggressive mixes look considerably more attractive than in the one-year chart. The likelihood of Mix 6 beating the 7.8% target over the 13.9 year period is 50% the same as the probability shown in the one year chart. However, the more aggressive mixes are shown as more likely to exceed the 7.8% target, with Mix 10 having a 55% chance of exceeding the 7.8% target, versus 51% in the one year chart.

SCENARIO 2: GLOBAL ASSET CLASSES

As discussed earlier, we conducted a parallel study using global asset classes. To study the asset categories selected, we selected a representative index for each that both captures the characteristics of the category and is well-defined:

(1) Global Equities (MSCI All Country World Index (ACWI));
(2) Global Fixed Income (Lehman Global Aggregate Bond Index);
(3) High Yield Fixed Income (Merrill Lynch Master II High Yield Index);
(4) Long-Duration Fixed Income (Lehman Long Govt/Credit Index);
(5) Real Estate (NCREIF Index);
(6) Alternative Investments (UBS Private Equity Performance Indicator);
(7) Cash and Equivalents (91-day Treasury Bills); and
(8) Plan Liabilities as developed in the *Liability Analysis* section of this report, shown as a "negative asset" that other assets serve to offset.

Expected Returns and Uncertainty

Our model uses the expected annual return and the uncertainty of returns (standard deviation) for each asset class. Below are our projections for each asset class:

Asset Class	Return	Std Dev
Global Equities	8.80%	18.50%
Global Fixed Income	4.90	6.00
High Yield Fixed Income	6.50	9.00
Long Duration Fixed Income	6.00	8.00
Real Estate	7.50	14.00
Alternative Investments	12.75	30.00
Cash	3.00	1.25
Liabilities	n/a	20.07[3]

Derivation of the assets' estimates is described in the *Appendix A - Basis for Capital Market Assumptions*. The liabilities' uncertainty was derived from their characteristics, primarily, the sensitivity of benefit payments to changes in interest rates (duration). The standard deviations for real estate and alternative investments reflect our estimate of the underlying variability of the asset classes, and are higher than the appraisal-based values sometimes used.

The projections reflect our assessment of returns and risks over the next five years, and we believe also approximate how investors in aggregate would expect these assets to perform.

[3] $$LiabilityVolatility = \left(\frac{LiabilityDuration}{BondMarketDuration}\right) \times \left(BondVolatility\right) \times \left(\frac{PlanLiabilities}{PlanAssets}\right)$$

Correlations

The following "correlation matrix" indicates the extent to that we project an increase in the value of one asset class will match an increase in the value of another. For example, the boldface **"0.15%"** shows that roughly 15% of increases or decreases in global equity returns correspond to similar moves in global fixed income securities.

	Global Eq	Global Fixed	High Yield	Long Bonds	Real Estate	Alternatives	Cash	Liabilities
Global Eq	****							
Global Fixed	0.15	****						
High Yield	0.57	0.40	****					
Long Bonds	0.20	0.90	0.40	****				
Real Estate	0.50	0.40	0.39	0.28	****			
Alternatives	0.73	0.10	0.41	0.13	0.57	****		
Cash	0.00	0.28	0.13	0.17	0.02	0.00	****	
Liabilities	0.24	0.85	0.34	0.96	0.18	0.06	0.10	****

The correlations used in this projection are close to their recent historical values as shown in *Appendix A – Basis for Capital Market Assumptions*. Correlations to the liabilities are derived by analyzing the sensitivities in the previous section.

Since the present value of pension liabilities is determined most importantly by interest rates, the correlation of long-duration bonds to liabilities is high: 96%. Equities' values are more sensitive to the changes in perceived "real" returns. Some of equities' volatility is also due to changing interest rates, as shown by their correlation to bonds. Additionally, equities' returns significantly depend on investor perceptions of future economic growth, which have limited impact on our liability computations. International equities have positive correlation to the liabilities through their similarity to domestic equity returns.

Real estate correlates to the liabilities through its sensitivity to interest rates and its correlation to bonds. Alternative investments are quite different from traditional asset classes and the liabilities. They have a fairly high correlation with equities but are virtually uncorrelated with the liabilities. T-Bills are correlated to the liabilities through their correlation to bonds; low total volatility of T-Bills limit the T-Bills correlations.

Constraints

Some asset classes were constrained to limit consideration to reasonable mixes; this did not unduly restrict choices. As in the earlier version of the asset mix using traditional asset classes, long-duration fixed income was constrained to 5% of assets and alternative investments were constrained to 8% of assets (to prevent a 100% alternative investment option as the highest return option). Also, a minimum of 0.5% was specified for short term fixed income. Cash and equivalents are undesirable investments for a long-term liability stream, but some cash-on-hand is necessary in the course of operations. We advise reducing cash as much as possible.

Optimal Asset Mixes for Given Risk Levels - Broad Asset Mix, Global Asset Classes

	Limits		*Asset Mix Alternatives*										
Component	min	max	*I*	*II*	*III*	*IV*	*V*	***VI***	***VII***	***VIII***	*IX*	*X*	Target
Global Equity	0.0	100.0	1.5	13.5	21.0	23.0	32.0	**43.0**	**48.0**	**52.0**	64.0	91.5	54.5
Global Fixed	0.0	100.0	93.0	81.0	71.5	65.0	54.5	**42.5**	**27.0**	**8.0**	0.0	0.0	29.0
High Yield	0.0	100.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**3.0**	**10.5**	1.5	0.0	2.0
Long Bonds	0.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**	**5.0**	**5.0**	5.0	0.0	0.0
Real Estate	0.0	100.0	0.0	0.0	0.0	0.0	0.0	**1.0**	**8.5**	**16.0**	21.0	0.0	9.0
Alternatives	0.0	8.0	0.0	0.0	2.0	6.5	8.0	**8.0**	**8.0**	**8.0**	8.0	8.0	5.0
Cash	0.5	100.0	0.5	0.5	0.5	0.5	0.5	**0.5**	**0.5**	**0.5**	0.5	0.5	0.5
Return, %/yr			5.0	5.5	5.9	6.4	6.8	**7.3**	**7.7**	**8.2**	8.6	9.1	7.7
Standard Deviation, %/yr			6.0	6.1	6.8	7.8	9.1	**10.8**	**12.2**	**13.6**	15.6	18.8	12.5
Total Plan Risk, %/yr			15.2	15.3	15.8	16.4	17.2	**18.3**	**19.4**	**20.7**	22.1	24.2	19.7

Mixes I–X in this table make up the range of optimal portfolio mixes excluding emerging markets, the "efficient frontier." (We use Roman Numerals to differentiate these mixes from the narrower set of mixes that follows.) Mixes VI, VII and VIII, shown in bold, will be the focus of analysis in the next section of the report. Each of the ten mixes offers the highest possible expected return given the limits for a given level of fund uncertainty – Total Plan Risk.

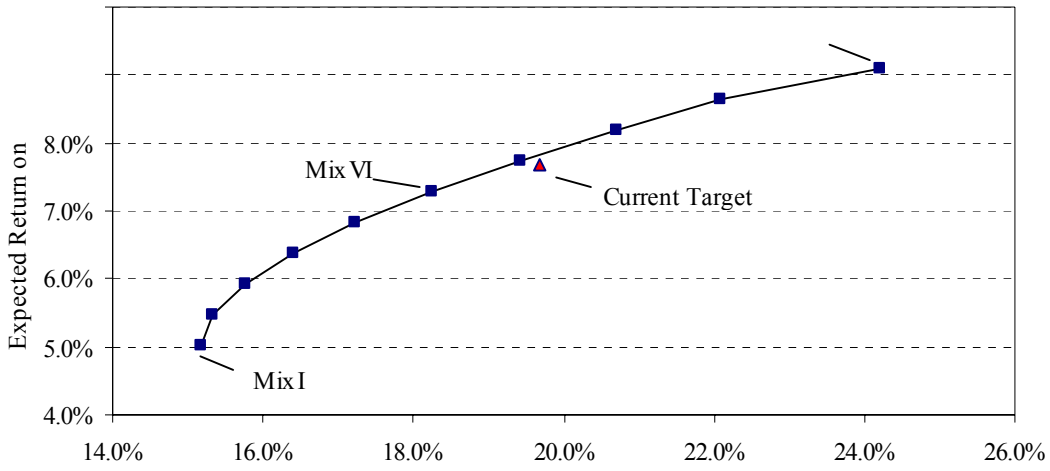


Figure 13

In Figure 13, the 10 "optimal" asset mixes are displayed on a risk/return graph, together with the current target (with and without commodities). A reassuring finding of this analysis is that the current actual mix is essentially on the efficient frontier.

While the output of our model specifies ten optimal assets mixes, there are virtually an infinite number of efficient asset mixes. Between each risk-reward point in the above table there are many slightly different efficient risk/reward asset mix portfolios. Because the mixes I through V, and IX through X seem inappropriate, we derived additional efficient mixes within the range of mixes VI through VIII. The results are shown below:

Optimal Asset Mixes for Given Risk Levels:
Narrowed Risk/Reward Range, Global Asset Classes

	Limits		*Asset Mix Alternatives*										
Component	min	max	*1*	*2*	*3*	*4*	***5***	***6***	***7***	*8*	*9*	*10*	Target
Global Equitie	0.0	100.0	43.5	45.0	46.0	47.5	**48.0**	**49.0**	**49.5**	50.0	51.0	52.0	54.5
Global Fixed	0.0	100.0	42.0	38.5	35.5	32.0	**28.0**	**24.0**	**20.0**	16.0	12.0	7.5	29.0
High Yield	0.0	100.0	0.0	0.0	0.0	1.0	**2.5**	**4.0**	**6.0**	8.0	9.0	11.0	2.0
Long Bonds	0.0	5.0	5.0	5.0	5.0	5.0	**5.0**	**5.0**	**5.0**	5.0	5.0	5.0	0.0
Real Estate	0.0	100.0	1.0	3.0	5.0	6.0	**8.0**	**9.5**	**11.0**	12.5	14.5	16.0	9.0
Alternatives	0.0	8.0	8.0	8.0	8.0	8.0	**8.0**	**8.0**	**8.0**	8.0	8.0	8.0	5.0
Cash	0.5	100.0	0.5	0.5	0.5	0.5	**0.5**	**0.5**	**0.5**	0.5	0.5	0.5	0.5
Return, %/yr			7.3	7.4	7.5	7.6	**7.7**	**7.8**	**7.9**	8.0	8.1	8.2	7.7
Standard Deviation, %/yr			10.9	11.2	11.5	11.8	**12.1**	**12.4**	**12.7**	13.0	13.3	13.7	12.5
Total Plan Risk, %/yr			18.3	18.6	18.8	19.1	**19.3**	**19.6**	**19.9**	20.2	20.5	20.8	19.7

In Figure 14, the 10 narrowed "optimal" asset mixes are displayed on a risk/ return graph, together with the current target. We will focus on Mixes 5, 6 and 7, as well as the current target in the next section of the report.

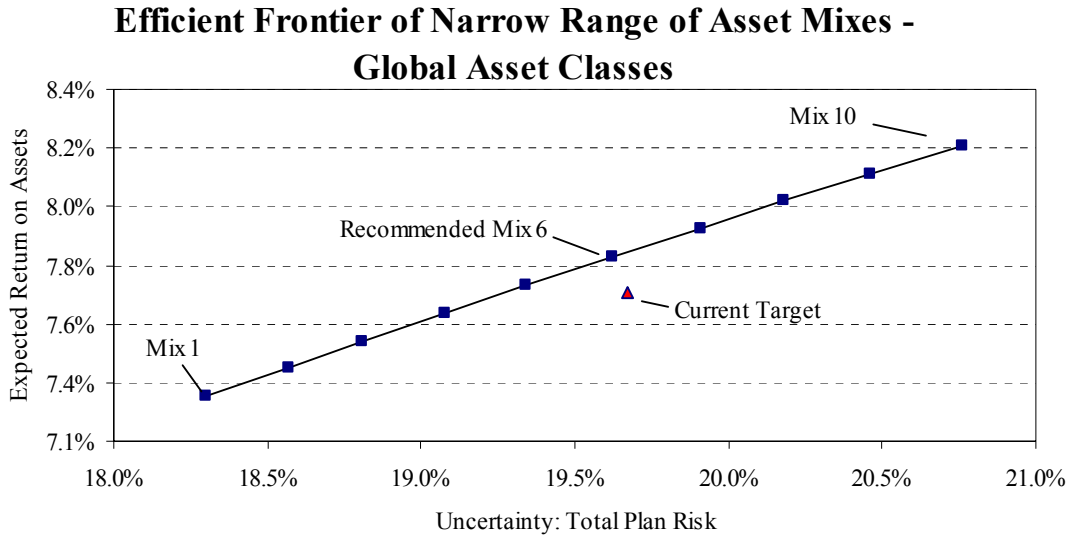


Figure 14

IMPLICATIONS FOR ACHIEVING THE ACTUARIAL INTEREST RATE - GLOBAL ASSET CLASSES

As with the traditional asset classes, we consider how the choice of one of the global asset mixes will impact Plan achievement of target returns.

Figure 14 on page 27 showed the annual expected return and the estimated Total Plan Risk for each of the ten efficient mixes. In Figure 15, below, we focus on the narrowed range of mixes and the current target mix. We look at the volatility (standard deviation) of each portfolio, and estimate the probability of the portfolio exceeding the 7.8% target rate of return.

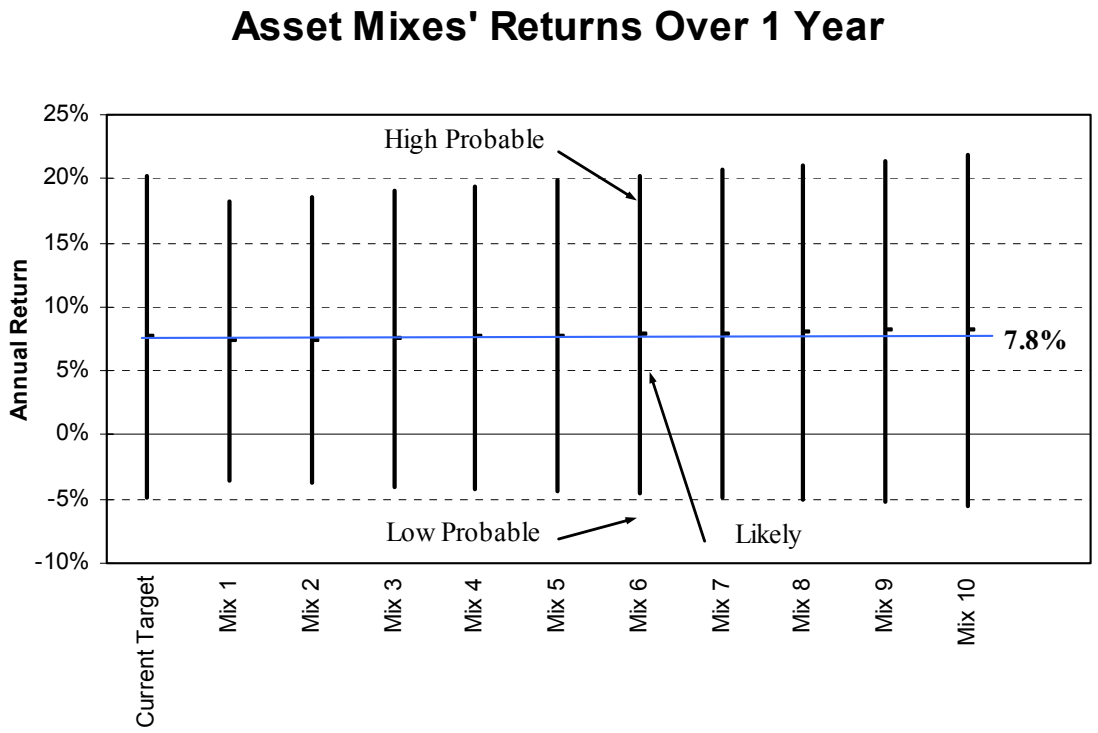


Figure 15

Mix 6 has an expected return of 7.8% per year, with a portfolio standard deviation of 12.4% per year (compared to 11.7% in the traditional asset mix scenario). In both scenarios, Mix 6 is expected to deliver the desired 7.8% per year rate of return. While the standard deviation is higher under the global asset class structure, the difference is not significant.

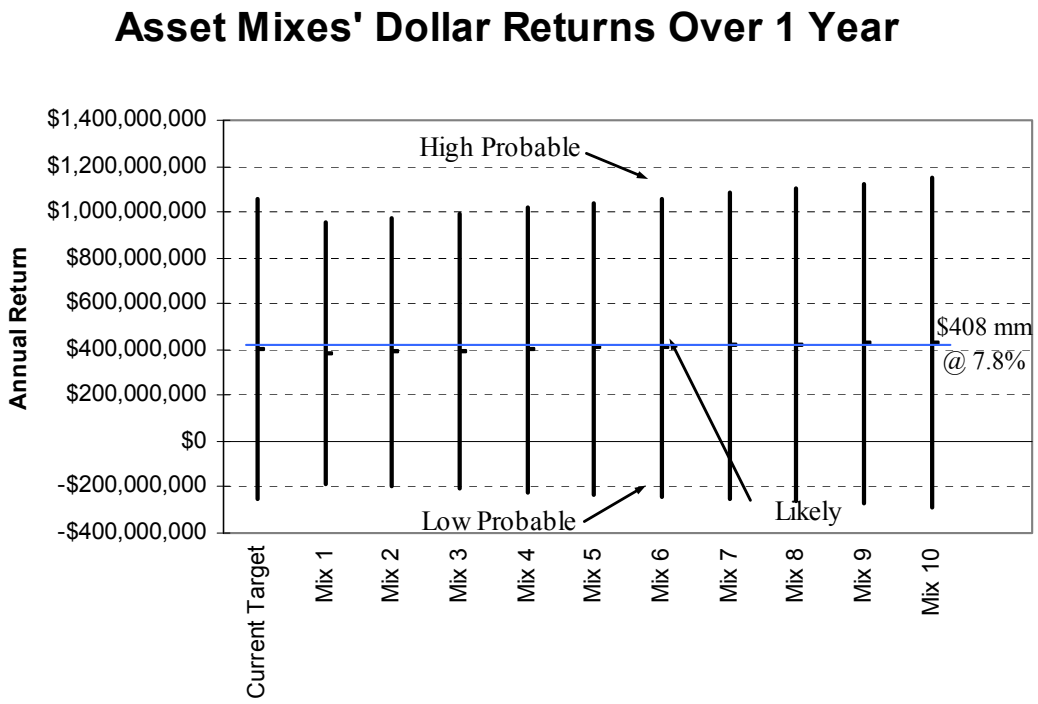


Figure 16

We also present the information from the previous chart in dollar terms. The return target of 7.8% becomes a dollar return target of approximately $408 million on the $5.2 billion in assets. Figure 16 translates the data from Figure 15 into dollar terms.

Longer-term Perspective

We also examine the expected returns and variance of returns over a five year time period. As shown in the Figure 17 below, the expected range of returns is narrower than the range in over the one year period. The expected return of each mix has a slightly higher probability of achieving the actuarial rate of return over the five year period versus the one year period.

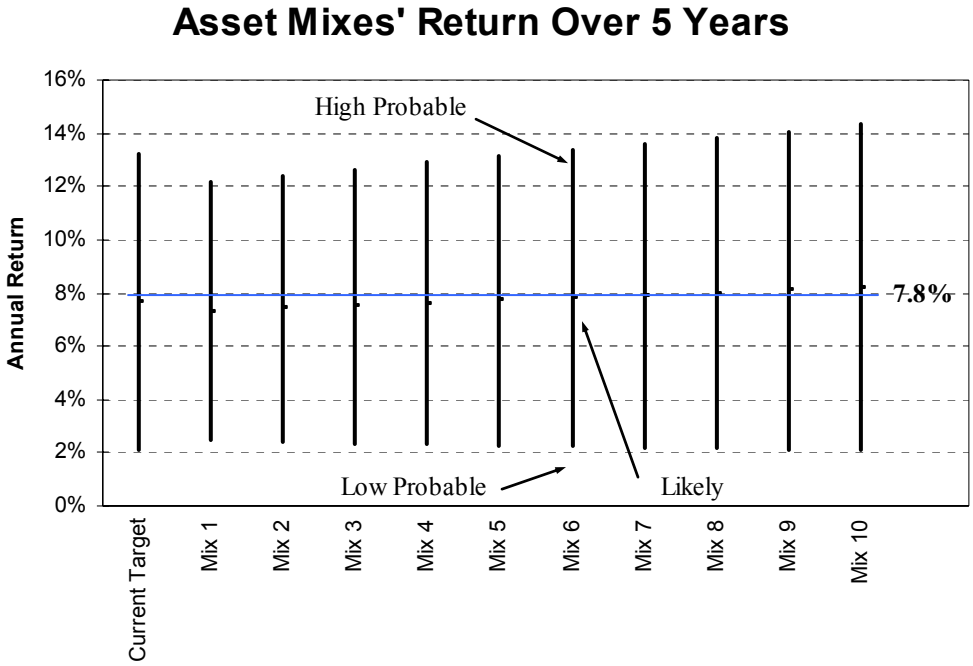


Figure 17

We also examine the expected returns and variance of returns over a longer time period. We believe that the appropriate policy frame is the time until the average liability is paid off – the "duration" of the liabilities. We recommend this planning horizon since it corresponds to actual benefits, rather than either the quarter-by-quarter perspective of the capital markets or the actuary's long-term perspective. In the liability section of this report, we reported its estimated value at 13.9 years. Looking at the longer horizon smoothes out short-term fluctuations.

Figure 18

Figure 18, above, shows how the expected range of return narrows when variability is spread over the 13.9 year liability horizon. The uncertainties appear substantially "tamed". Taking the longer view to risk makes the more aggressive mixes look considerably more attractive than in the one-year chart. The likelihood of Mix 5 beating the 7.8% target over the 13.9 year period is 50% the same as the probability shown in the one year chart. However, the more aggressive mixes are shown as more likely to exceed the 7.8% target, with Mix 10 having a 54% chance of exceeding the 7.8% target, versus 51% in the one year chart.

RECOMMENDATION AND CONCLUSION

A case could be made why the Plan might wish to adopt any of the proposed asset mixes. Narrowed Mix 6 under both the Traditional and Global Asset Class approaches is expected to deliver an expected 7.8% rate of return over the next 3-5 years. Mixes 5 and 7 under each scenario are also reasonable alternatives. The Board must determine which scenario, Traditional or Global, they are more comfortable with. Under either approach, we recommend adoption of Mix 6.

We conclude that the current asset mix is close to optimal in terms of return for the risk taken. We propose the adoption of Mix 6 which is close to the current target asset allocation. Under the Traditional approach, moving to Mix 6 would effectively decrease the domestic equity allocation by 10%, increase international equity by 7%, increase domestic fixed income by 4% (but shift 2% out of domestic core fixed income while adding 1% to high yield and 5% to long bonds. The non-US fixed income allocation comes in 2% lower (however, now that this has been converted to a global mandate, the current 4% allocation is allocated roughly equally between US and non-US securities). The allocation to alternative investment would rise by 3%. The real estate allocation and cash allocations are unchanged.

Under the Global approach, moving to Mix 6 would effectively reduce the global equity allocation by 5.5%, increase overall fixed income by 2% (but shift 5% out of core fixed income while adding 2% to high yield and 5% to long bonds. The real estate allocation would be increased by 0.5% and the allocation to alternative investment would rise by 3%. The cash would be unchanged.

The Current Target, Proposed and Alternative Asset Mixes are detailed on the following page for both the Traditional and Global Asset Class approaches.

Traditional Asset Mixes

Component	Current Target	Alternative Mix 5	Recommended Mix 6	Alternative Mix 7	Proposed Ranges of Mix 6
Domestic Equities	43.0	33.5	33.0	33.0	30-36%
International Equities	11.5	17.0	18.5	19.5	16-21%
Domestic Bonds	23.0	20.0	21.0	19.0	18-24%
High Yield	2.0	2.0	3.0	4.0	1-3%
Long Bonds	0.0	5.0	5.0	5.0	0-6%
Intl Bonds	4.0	6.0	2.0	0.0	0-4%
Real Estate	9.0	8.0	9.0	11.0	6-10%
Alternatives	5.0	8.0	8.0	8.0	5-10%
Cash	0.5	0.5	0.5	0.5	0-1%
Return, %/yr	7.6	7.7	7.8	7.9	
Standard Deviation, %/yr	11.4	11.5	11.7	12.0	
Total Plan Risk, %/yr	19.1	18.9	19.2	19.4	

Global Asset Mixes

Component	Current Target	Alternative Mix 5	Recommended Mix 6	Alternative Mix 7	Proposed Ranges of Mix 6
Global Equities	54.5	48.0	49.0	49.5	45-53%
Global Fixed	29.0	28.0	24.0	20.0	20-28%
High Yield	2.0	2.5	4.0	6.0	2-6%
Long Bonds	0.0	5.0	5.0	5.0	4-6%
Real Estate	9.0	8.0	9.5	11.0	6-12%
Alternatives	5.0	8.0	8.0	8.0	5-10%
Cash	0.5	0.5	0.5	0.5	0-1%
Return, %/yr	7.7	7.7	7.8	7.9	
Standard Deviation, %/yr	12.5	12.1	12.4	12.7	
Total Plan Risk, %/yr	19.7	19.3	19.6	19.9	

APPENDIX A - BASIS FOR CAPITAL MARKET ASSUMPTIONS

Domestic Equities: Expected returns for stocks are derived from analyses of historic returns, forecasts of the Russell 3000® Index performance, and the expected economic environment. Return expectations are based on an analysis of historical results, consensus expectation and our proprietary analysis. Risk (the annual standard deviation of returns for stocks) is estimated based on historical data over different time periods.

International Equities: Expected returns and risk (standard deviation) are estimated for the Morgan Stanley Capital International Europe, Australia and Far East (MSCI EAFE) Index on a U.S. Dollar basis.

Emerging Market Equities: Expected returns and risk (standard deviation) are estimated for the Morgan Stanley Capital International Emerging Markets Index on a U.S. Dollar basis.

Domestic Fixed Income: Expected returns and risk (standard deviation) for bonds are projected for the Lehman Universal Bond Index.

Domestic High Yield Fixed Income: Expected returns and risk levels (standard deviation) are estimated for the high yield fixed income asset class using the Merrill Lynch High Yield Master II Bond Index data.

Long-Duration Fixed Income: Expected returns and risk (standard deviation) for bonds are projected for the Lehman Long Government/Credit Bond Index.

Emerging Market Debt: Expected returns and risk (standard deviation) for bonds are projected for the JP Morgan Emerging Market Bond Index

Treasury Inflation Protected Securities: Expected returns and risk (standard deviation) for TIPS are projected for the Lehman US TIPS Index. Risk is based on historical experience.

Non-US Fixed Income: Expected returns and risk (standard deviation) are projected using the JP Morgan Global Bond Index ex-US (Unhedged) Index. Risk is based on historical experience.

Private Real Estate: Expected returns and risk (standard deviation) are estimated using historical returns for institutional real estate investments. Historical data was analyzed using the NCREIF Index.

Public Real Estate: Expected returns and risk (standard deviation) are estimated using historical returns for publicly-traded real estate investments. Historical data was analyzed using the FTSE EPRA/NAREIT Global Real Estate Index.

Alternative Investments: Expected returns and risk (standard deviation) are estimated using UBS Private Equity Performance Indicator.

Commodities: Expected returns and risk (standard deviation) are estimated using the Dow Jones AIG Commodities Index.

91-Day Treasury Bills: Expected returns and risk (standard deviation) for 91-day Treasury Bills was estimated using historical data.

Comparative Historical Returns, Standard Deviations and Correlations

As of December 31, 2007

Historical Returns:	Russell 3000	MSCI EAFE	MSCI EM	LB Uni	ML HiYld II	LB TIPS	LB Long	JPM Non-US	NCREIF	Global REIT	DJ Com
3-Yr	8.90	17.31	35.60	4.73	5.42	4.85	4.88	2.58	17.48	15.17	12.92
5-Yr	13.63	22.08	37.46	4.99	10.72	6.27	5.80	7.49	15.13	24.29	14.26
7-Yr	4.00	8.78	23.98	6.11	7.92	7.92	7.26	7.77	12.75	16.62	10.20
10-Yr	6.21	9.04	14.53	6.08	5.48	7.46	6.95	6.22	12.91	12.81	8.97
20-Yr	11.89	7.79	16.34	6.57	8.02	3.80	9.00	6.68	8.76	9.72	6.69

Historical Risk:	Russell 3000	MSCI EAFE	MSCI EM	LB Uni	ML HiYld II	LB TIPS	LB Long	JPM Non-US	NCREIF	Global REIT	DJ Com
3-Yr	6.55	8.19	13.59	3.08	3.65	4.63	6.76	6.61	1.37	15.81	13.92
5-Yr	10.07	13.53	17.82	3.31	5.71	4.79	7.32	7.62	1.96	16.32	13.22
7-Yr	17.79	19.35	25.45	3.35	7.69	5.18	7.21	9.29	2.42	16.85	13.72
10-Yr	18.72	19.84	30.96	3.12	7.23	4.62	7.01	9.34	2.11	16.68	14.55
20-Yr	15.73	18.84	28.73	3.94	7.61	4.51	7.71	10.09	3.50	18.14	12.50

3-Yr Correlations:	Russell 3000	MSCI EAFE	MSCI EM	LB Uni	ML HiYld II	LB TIPS	LB Long	JPM Non-US	NCREIF	Global REIT	DJ Com
Russell 3000	1.00	0.83	0.75	-0.03	0.74	-0.45	-0.15	-0.23	0.37	0.68	-0.31
MSCI EAFE	0.83	1.00	0.76	-0.40	0.52	-0.66	-0.57	-0.16	0.18	0.57	0.12
MSCI Emerging Markets	0.75	0.76	1.00	-0.14	0.25	-0.32	-0.26	-0.02	0.22	0.33	0.16
Lehman Universal	-0.03	-0.40	-0.14	1.00	0.38	0.82	0.94	0.39	-0.12	0.19	-0.47
ML High Yield II	0.74	0.52	0.25	0.38	1.00	-0.13	0.22	-0.05	0.18	0.88	-0.48
LB US TIPS	-0.45	-0.66	-0.32	0.82	-0.13	1.00	0.79	0.51	-0.31	-0.26	-0.13
LB Long Gov/Crd	-0.15	-0.57	-0.26	0.94	0.22	0.79	1.00	0.18	0.01	0.07	-0.47
JPM Non-US	-0.23	-0.16	-0.02	0.39	-0.05	0.51	0.18	1.00	-0.55	-0.06	0.17
NCREIF	0.37	0.18	0.22	-0.12	0.18	-0.31	0.01	-0.55	1.00	0.27	-0.27
FTSE EPRA/NAREIT Global	0.68	0.57	0.33	0.19	0.88	-0.26	0.07	-0.06	0.27	1.00	-0.31
DJ AIG Commodity Index	-0.31	0.12	0.16	-0.47	-0.48	-0.13	-0.47	0.17	-0.27	-0.31	1.00
UBS Private Equity	-0.45	-0.11	-0.21	-0.43	-0.44	-0.10	-0.40	-0.06	-0.37	-0.27	0.50
91-Day T-Bill	0.33	0.24	0.18	0.33	0.36	0.23	0.07	0.64	-0.30	0.12	-0.25

5-Yr Correlations:	Russell 3000	MSCI EAFE	MSCI EM	LB Uni	ML HiYld II	LB TIPS	LB Long	JPM Non-US	NCREIF	Global REIT	DJ Com
Russell 3000	1.00	0.93	0.75	0.05	0.59	-0.09	0.02	0.28	-0.02	0.66	-0.12
MSCI EAFE	0.93	1.00	0.82	-0.07	0.42	-0.16	-0.12	0.30	0.03	0.66	0.09
MSCI Emerging Markets	0.75	0.82	1.00	0.22	0.38	0.11	0.15	0.35	0.08	0.60	0.23
Lehman Universal	0.05	-0.07	0.22	1.00	0.48	0.87	0.96	0.41	-0.11	0.32	-0.08
ML High Yield II	0.59	0.42	0.38	0.48	1.00	0.29	0.41	0.44	-0.39	0.63	-0.09
LB US TIPS	-0.09	-0.16	0.11	0.87	0.29	1.00	0.85	0.53	-0.25	0.11	0.13
LB Long Gov/Crd	0.02	-0.12	0.15	0.96	0.41	0.85	1.00	0.29	-0.04	0.25	-0.12
JPM Non-US	0.28	0.30	0.35	0.41	0.44	0.53	0.29	1.00	-0.31	0.34	0.14
NCREIF	-0.02	0.03	0.08	-0.11	-0.39	-0.25	-0.04	-0.31	1.00	0.00	-0.30
FTSE EPRA/NAREIT Global	0.66	0.66	0.60	0.32	0.63	0.11	0.25	0.34	0.00	1.00	-0.08
DJ AIG Commodity Index	-0.12	0.09	0.23	-0.08	-0.09	0.13	-0.12	0.14	-0.30	-0.08	1.00
UBS Private Equity	-0.27	0.00	0.03	-0.27	-0.63	-0.13	-0.27	-0.29	0.15	-0.12	0.41
91-Day T-Bill	-0.14	-0.09	0.04	0.10	-0.37	-0.05	-0.01	-0.09	0.54	-0.20	-0.18

7-Yr Correlations:	Russell 3000	MSCI EAFE	MSCI EM	LB Uni	ML HiYld II	LB TIPS	LB Long	JPM Non-US	NCREIF	Global REIT	DJ Com
Russell 3000	1.00	0.90	0.87	-0.42	0.63	-0.51	-0.37	-0.15	0.24	0.68	0.06
MSCI EAFE	0.90	1.00	0.86	-0.41	0.48	-0.47	-0.38	0.09	0.31	0.76	0.18
MSCI Emerging Markets	0.87	0.86	1.00	-0.29	0.60	-0.34	-0.26	-0.12	0.22	0.69	0.23
Lehman Universal	-0.42	-0.41	-0.29	1.00	0.03	0.85	0.95	0.43	-0.21	-0.06	-0.14
ML High Yield II	0.63	0.48	0.60	0.03	1.00	-0.15	0.01	-0.15	-0.01	0.50	-0.01
LB US TIPS	-0.51	-0.47	-0.34	0.85	-0.15	1.00	0.83	0.44	-0.25	-0.16	0.09
LB Long Gov/Crd	-0.37	-0.38	-0.26	0.95	0.01	0.83	1.00	0.36	-0.12	-0.06	-0.10
JPM Non-US	-0.15	0.09	-0.12	0.43	-0.15	0.44	0.36	1.00	-0.18	0.15	0.13
NCREIF	0.24	0.31	0.22	-0.21	-0.01	-0.25	-0.12	-0.18	1.00	0.20	-0.02
FTSE EPRA/NAREIT Global	0.68	0.76	0.69	-0.06	0.50	-0.16	-0.06	0.15	0.20	1.00	0.05
DJ AIG Commodity Index	0.06	0.18	0.23	-0.14	-0.01	0.09	-0.10	0.13	-0.02	0.05	1.00
UBS Private Equity	0.12	0.31	0.15	-0.25	-0.15	-0.17	-0.18	-0.03	0.61	0.14	0.40
91-Day T-Bill	-0.14	-0.17	-0.08	0.11	-0.18	-0.02	-0.03	-0.20	0.38	-0.22	-0.33

10-Yr Correlations:	Russell 3000	MSCI EAFE	MSCI EM	LB Uni	ML HiYld II	LB TIPS	LB Long	JPM Non-US	NCREIF	Global REIT	DJ Com
Russell 3000	1.00	0.88	0.78	-0.43	0.61	-0.52	-0.41	-0.24	0.20	0.62	-0.15
MSCI EAFE	0.88	1.00	0.77	-0.43	0.50	-0.51	-0.42	0.02	0.27	0.66	0.00
MSCI Emerging Markets	0.78	0.77	1.00	-0.40	0.56	-0.33	-0.41	-0.22	0.06	0.67	0.14
Lehman Universal	-0.43	-0.43	-0.40	1.00	-0.07	0.81	0.94	0.41	-0.13	-0.09	-0.10
ML High Yield II	0.61	0.50	0.56	-0.07	1.00	-0.21	-0.11	-0.18	0.00	0.49	-0.09
LB US TIPS	-0.52	-0.51	-0.33	0.81	-0.21	1.00	0.81	0.36	-0.25	-0.16	0.16
LB Long Gov/Crd	-0.41	-0.42	-0.41	0.94	-0.11	0.81	1.00	0.40	-0.05	-0.15	-0.09
JPM Non-US	-0.24	0.02	-0.22	0.41	-0.18	0.36	0.40	1.00	-0.08	-0.01	0.00
NCREIF	0.20	0.27	0.06	-0.13	0.00	-0.25	-0.05	-0.08	1.00	0.12	-0.14
FTSE EPRA/NAREIT Global	0.62	0.66	0.67	-0.09	0.49	-0.16	-0.15	-0.01	0.12	1.00	0.05
DJ AIG Commodity Index	-0.15	0.00	0.14	-0.10	-0.09	0.16	-0.09	0.00	-0.14	0.05	1.00
UBS Private Equity	0.02	0.10	-0.06	-0.16	-0.25	-0.04	-0.06	-0.12	0.37	-0.09	0.42
91-Day T-Bill	-0.11	-0.17	-0.27	0.15	-0.32	-0.01	0.04	-0.18	0.32	-0.25	-0.20

Global Equities: Expected returns for stocks are derived from analyses of historic returns, forecasts of the MSCI All Country World Index performance, and the expected economic environment. Return expectations are based on an analysis of historical results, consensus expectation and our proprietary analysis. Risk (the annual standard deviation of returns for stocks) is estimated based on historical data over different time periods.

Global Fixed Income: Expected returns and risk (standard deviation) for bonds are projected for the Lehman Global Bond Index.

High Yield Fixed Income: Expected returns and risk (standard deviation) for bonds are projected for the Lehman Global High Yield Bond Index.

Long-Duration Fixed Income: Expected returns and risk (standard deviation) for bonds are projected for the Lehman Long Government/Credit Bond Index.

Real Estate: Expected returns and risk (standard deviation) are estimated using historical returns for institutional real estate investments. Historical data was analyzed using the FTSE EPRA / NAREIT Global Real Estate Index.

Alternative Investments: Expected returns and risk (standard deviation) are estimated using UBS Private Equity Performance Indicator.

91-Day Treasury Bills: Expected returns and risk (standard deviation) for 91-day Treasury Bills was estimated using historical data.

Comparative Historical Returns, Standard Deviations and Correlations

As of December 31, 2007

Historical Returns:	**MSCI ACWI**	**Lehman Global Aggregate**	**Lehman Long Gov/Cred**	**FTSE EPRA/NAREIT**	**UBS Private Equity**	**91-Day T-Bill**
3-Yr	18.57	4.10	27.70	3.77	5.36	-100.00
5-Yr	15.43	6.28	24.16	2.76	6.55	-100.00
7-Yr	4.93	6.23	19.85	3.19	7.46	-100.00
10-Yr	7.63	5.56	12.16	3.80	7.36	-100.00
20-Yr	9.38	6.24	10.11	4.82	8.70	-100.00

Historical Risk:	MSCI ACWI	Lehman Global Aggregate	Lehman Long Gov/Cred	FTSE EPRA/NAREIT	UBS Private Equity	91-Day T-Bill
3-Yr	8.23	4.75	7.21	14.38	6.40	0.64
5-Yr	16.11	4.80	8.00	16.29	9.81	0.78
7-Yr	18.48	5.84	7.33	15.66	11.48	0.88
10-Yr	18.79	5.79	7.18	17.80	13.95	0.87
20-Yr	16.55	5.98	8.14	18.05	10.46	0.99

3-Yr Correlations:	MSCI ACWI	Lehman Global Aggregate	Lehman Long Gov/Cred	FTSE EPRA/NAREIT	UBS Private Equity	91-Day T-Bill
MSCI ACWI	1.00	-0.12	-0.37	0.58	-0.29	0.34
Lehman Global	-0.12	1.00	0.38	0.00	-0.20	0.70
Lehman Long Gov/Cred	-0.37	0.38	1.00	0.07	-0.40	0.07
FTSE EPRA/NAREIT	0.58	0.00	0.07	1.00	-0.27	0.12
UBS Private Equity	-0.29	-0.20	-0.40	-0.27	1.00	-0.26
91-Day T-Bill	0.34	0.70	0.07	0.12	-0.26	1.00

5-Yr Correlations:	MSCI ACWI	Lehman Global Aggregate	Lehman Long Gov/Cred	FTSE EPRA/NAREIT	UBS Private Equity	91-Day T-Bill
MSCI ACWI	1.00	0.30	-0.05	0.64	-0.13	-0.07
Lehman Global	0.30	1.00	0.49	0.39	-0.33	-0.03
Lehman Long Gov/Cred	-0.05	0.49	1.00	0.25	-0.27	-0.01
FTSE EPRA/NAREIT	0.64	0.39	0.25	1.00	-0.12	-0.20
UBS Private Equity	-0.13	-0.33	-0.27	-0.12	1.00	0.27
91-Day T-Bill	-0.07	-0.03	-0.01	-0.20	0.27	1.00

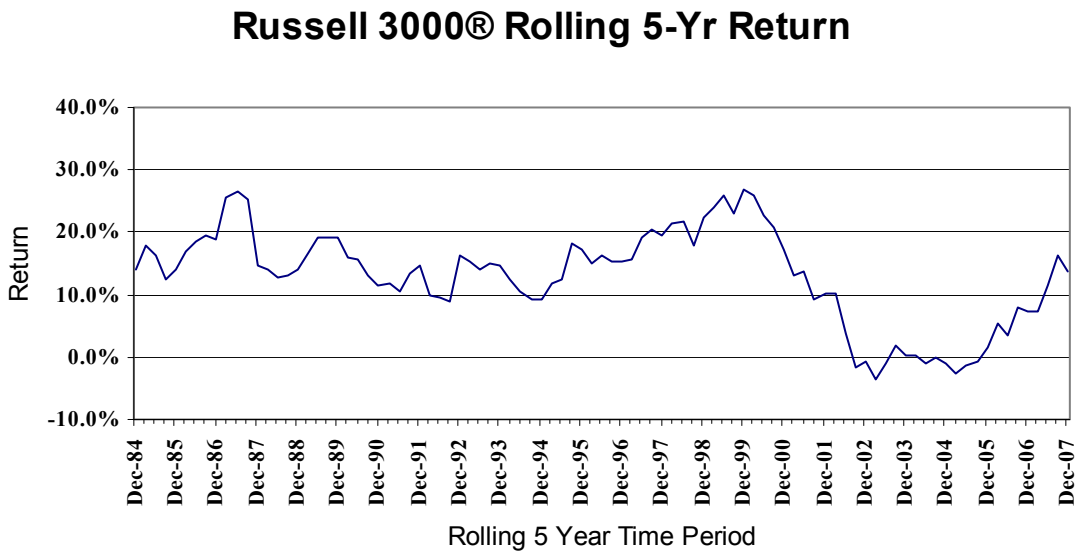
7-Yr Correlations:	MSCI ACWI	Lehman Global Aggregate	Lehman Long Gov/Cred	FTSE EPRA/NAREIT	UBS Private Equity	91-Day T-Bill
MSCI ACWI	1.00	-0.14	-0.38	0.72	0.23	-0.13
Lehman Global	-0.14	1.00	0.53	0.11	-0.09	-0.12
Lehman Long Gov/Cred	-0.38	0.53	1.00	-0.06	-0.18	-0.03
FTSE EPRA/NAREIT	0.72	0.11	-0.06	1.00	0.14	-0.22
UBS Private Equity	0.23	-0.09	-0.18	0.14	1.00	0.10
91-Day T-Bill	-0.13	-0.12	-0.03	-0.22	0.10	1.00

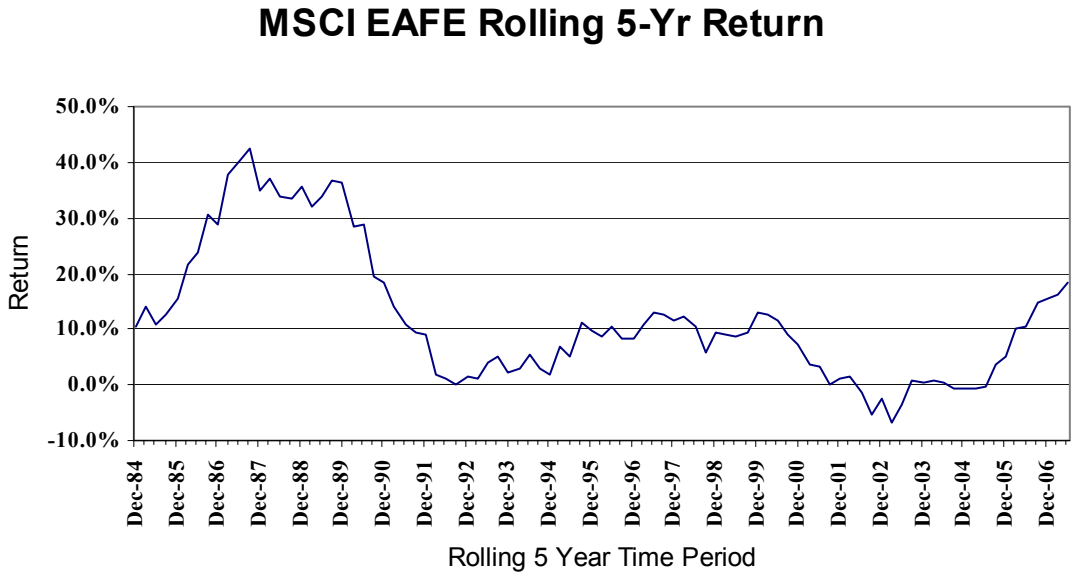
10-Yr Correlations:	MSCI ACWI	Lehman Global Aggregate	Lehman Long Gov/Cred	FTSE EPRA/NAREIT	UBS Private Equity	91-Day T-Bill
MSCI ACWI	1.00	-0.24	-0.44	0.64	0.05	-0.14
Lehman Global	-0.24	1.00	0.58	-0.05	-0.14	-0.11
Lehman Long Gov/Cred	-0.44	0.58	1.00	-0.15	-0.06	0.04
FTSE EPRA/NAREIT	0.64	-0.05	-0.15	1.00	-0.09	-0.25
UBS Private Equity	0.05	-0.14	-0.06	-0.09	1.00	0.32
91-Day T-Bill	-0.14	-0.11	0.04	-0.25	0.32	1.00

20-Yr Correlations:	MSCI ACWI	Lehman Global Aggregate	Lehman Long Gov/Cred	FTSE EPRA/NAREIT	UBS Private Equity	91-Day T-Bill
MSCI ACWI	1.00	-0.04	-0.04	0.45	-0.02	-0.05
Lehman Global	-0.04	1.00	0.69	0.06	-0.14	0.13
Lehman Long Gov/Cred	-0.04	0.69	1.00	-0.03	-0.10	0.13
FTSE EPRA/NAREIT	0.45	0.06	-0.03	1.00	-0.07	-0.21
UBS Private Equity	-0.02	-0.14	-0.10	-0.07	1.00	0.18
91-Day T-Bill	-0.05	0.13	0.13	-0.21	0.18	1.00

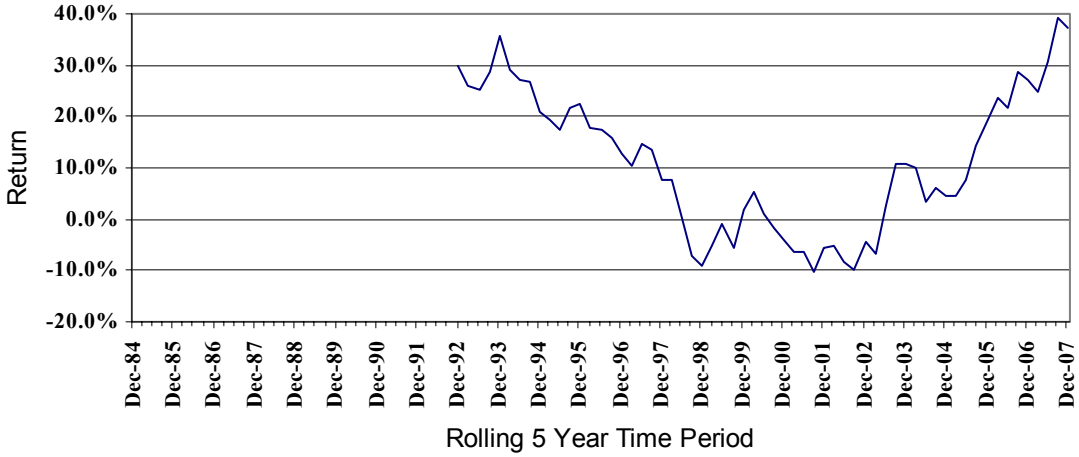
Rolling Five-Year Performance

We calculated the cumulative annualized returns of each asset class over multiple rolling 5-year time periods. For example, for stocks, we had data spanning over twenty years. We calculated a five-year return for the beginning of this period. This time period started with first quarter 1980 and went through fourth quarter 1984. Then the next quarter's return for the Russell 3000® was added to the respective time series and the oldest quarterly return was dropped. The stock return over this new five-year time period was then calculated. This procedure was repeated through the latest five-year period covering first quarter 2003 through fourth quarter 2007.

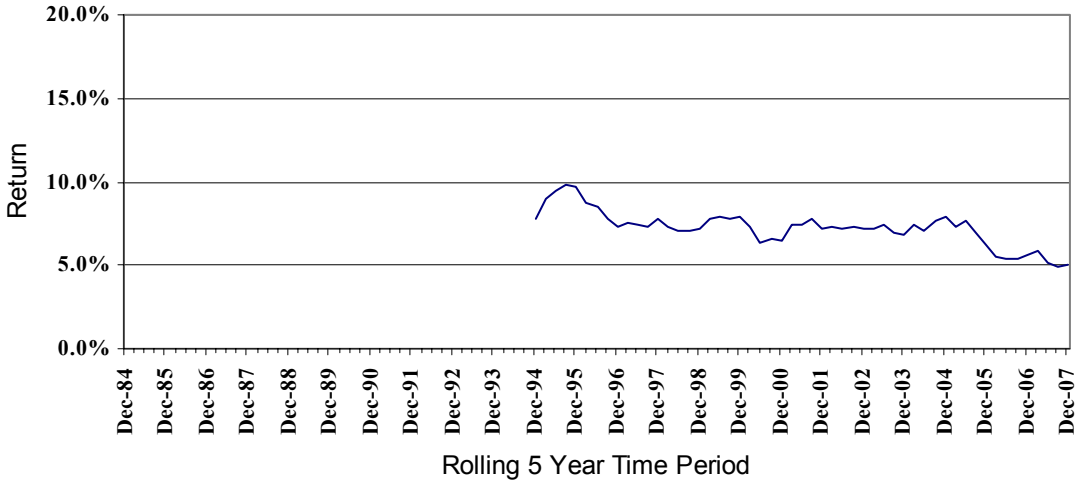




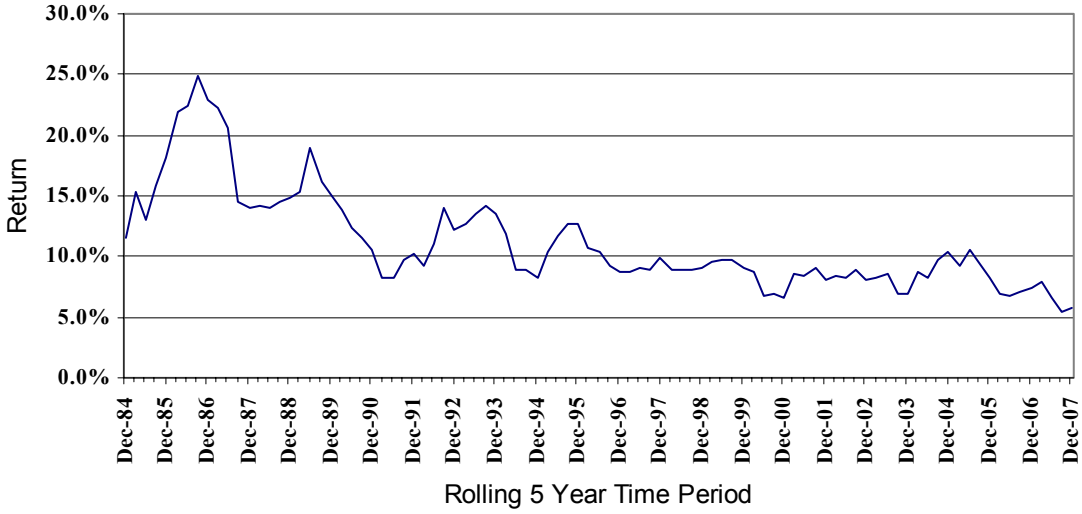
MSCI Emerging Markets Rolling 5-Yr Return



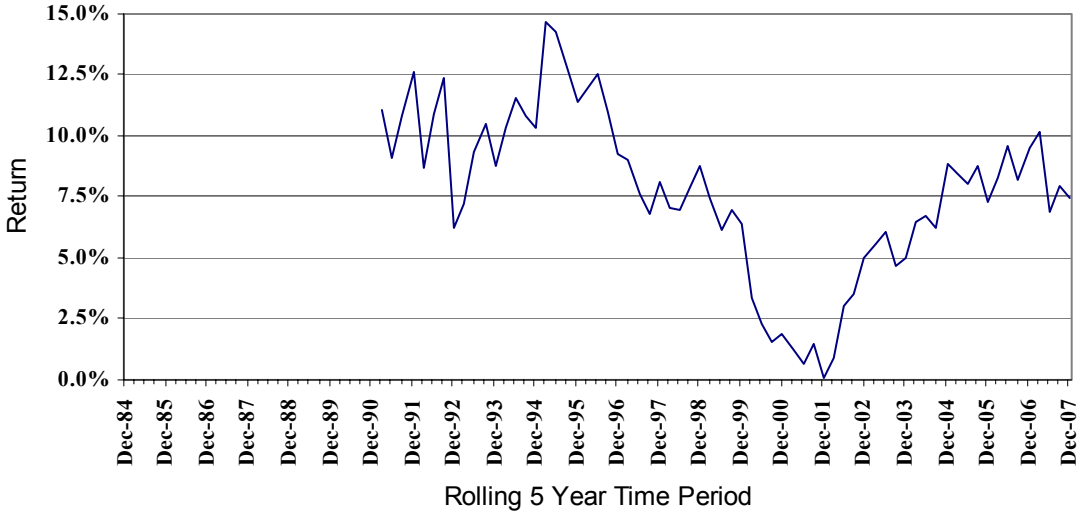
Lehman Universal Bond Rolling 5-Yr Return



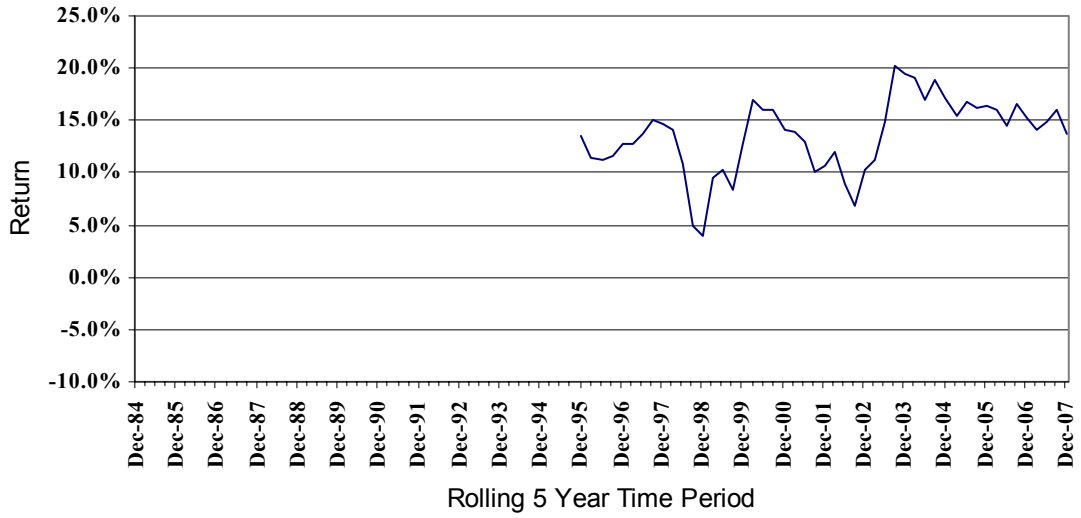
LB Long Gov/Credit Index Rolling 5-Yr Return



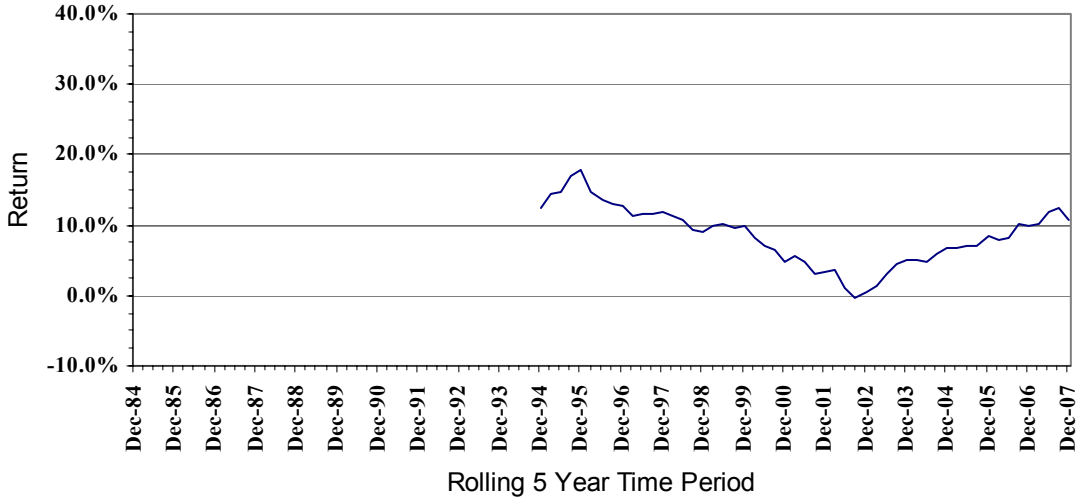
JPMorgan GBI ex-US Rolling 5-Yr Return



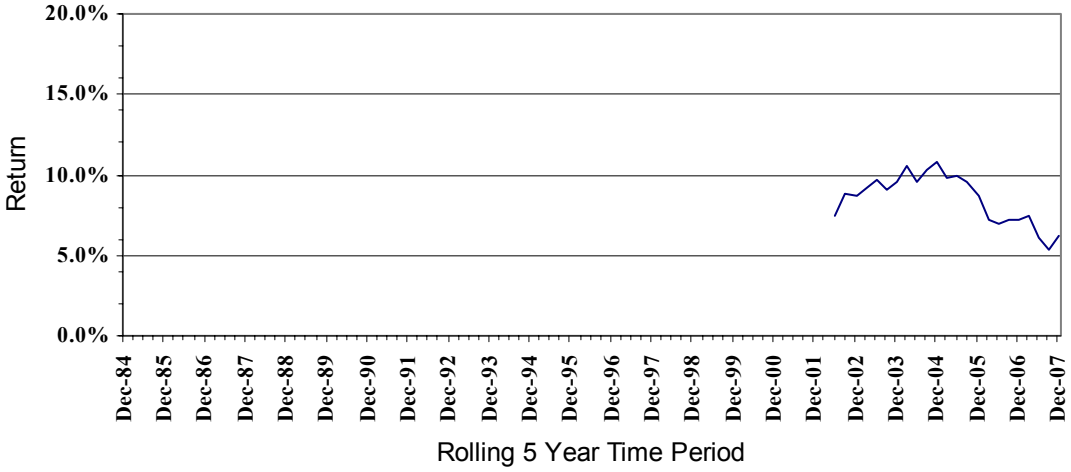
JP Morgan Emerging Markets Bond 5-Yr Return



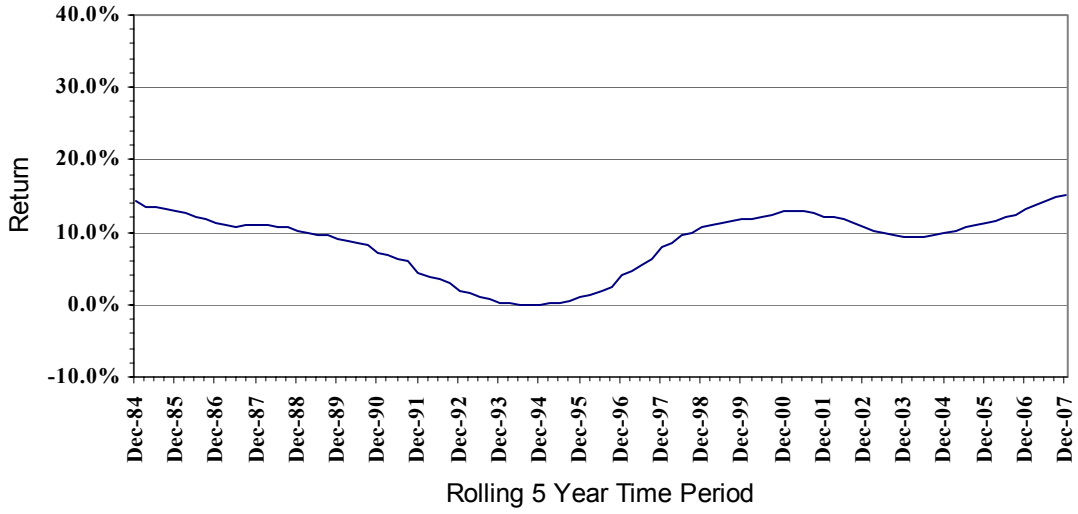
ML High Yield II Rolling 5-Yr Return



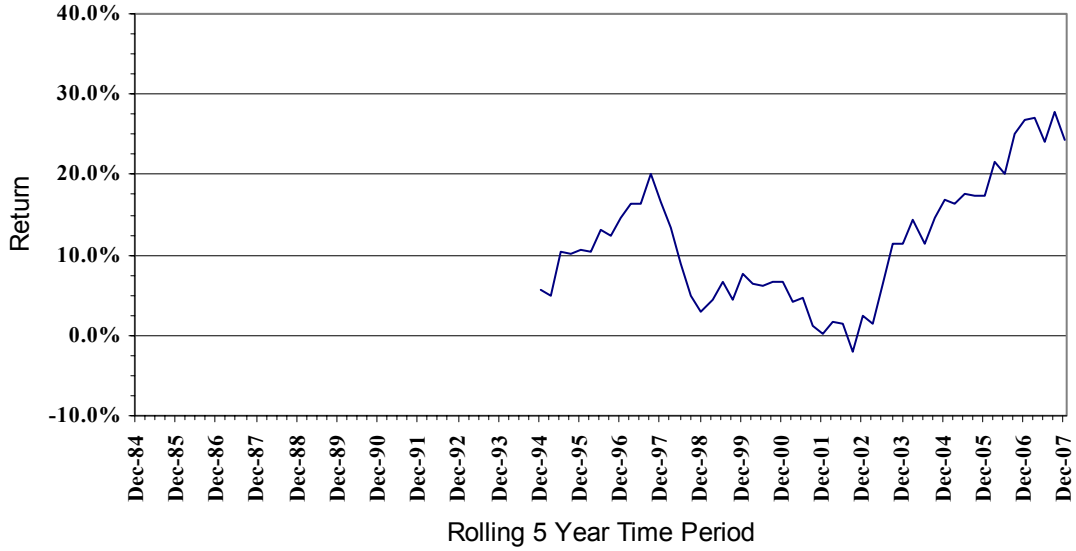
LB US TIPS Rolling 5-Yr Return



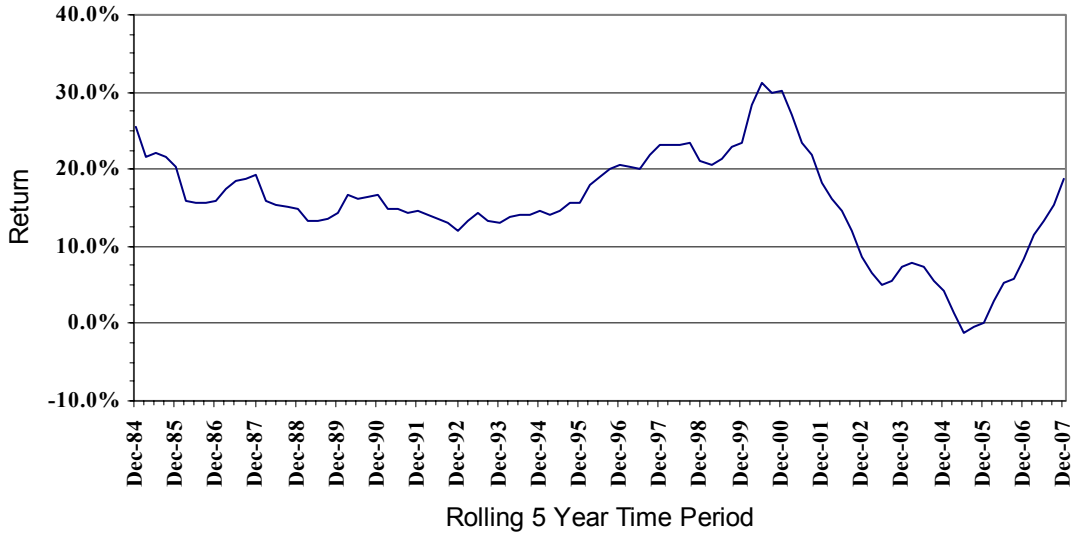
NCREIF Rolling 5-Yr Return



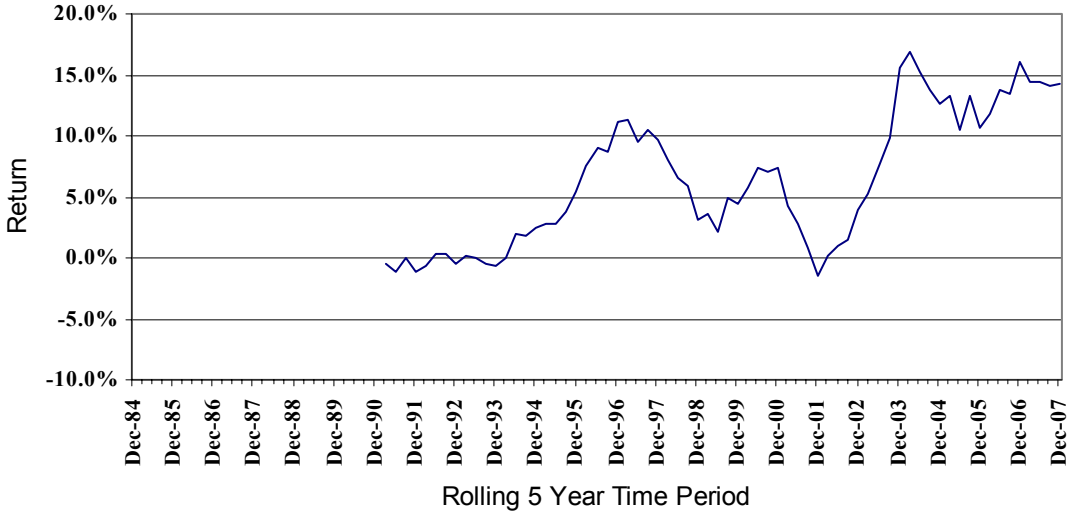
FSTE EPRA NAREIT Rolling 5-Yr Return



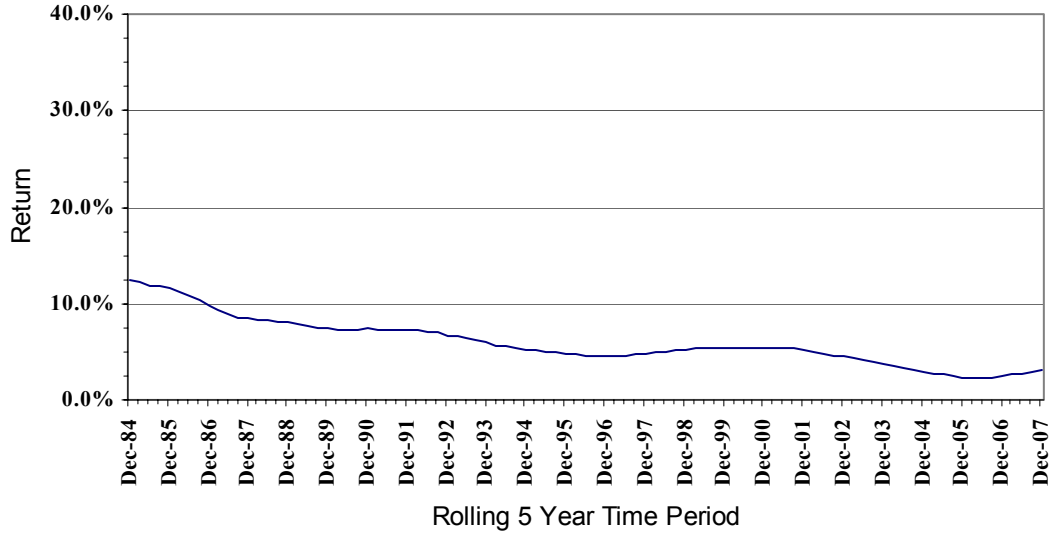
UBS Private Equity Rolling 5-Yr Return



DJ AIG Commodity Index 5-Yr Return



91 Day T-Bill Rolling 5-Yr Return



APPENDIX B – ASSET CLASS CORRELATIONS

As part of our research effort on the assumptions used in the asset allocation review, we review the correlation trends between bonds and the other asset classes. The correlation between bonds and other asset classes are particularly critical. Bonds are the asset class that is most highly correlated with plan liabilities, and thus are somewhat representative of the correlation between the liabilities and the asset classes. The correlation between the assets and the liabilities is central to the asset allocation process. These historical correlations are explored below.

Procedure Used to Calculate Correlations

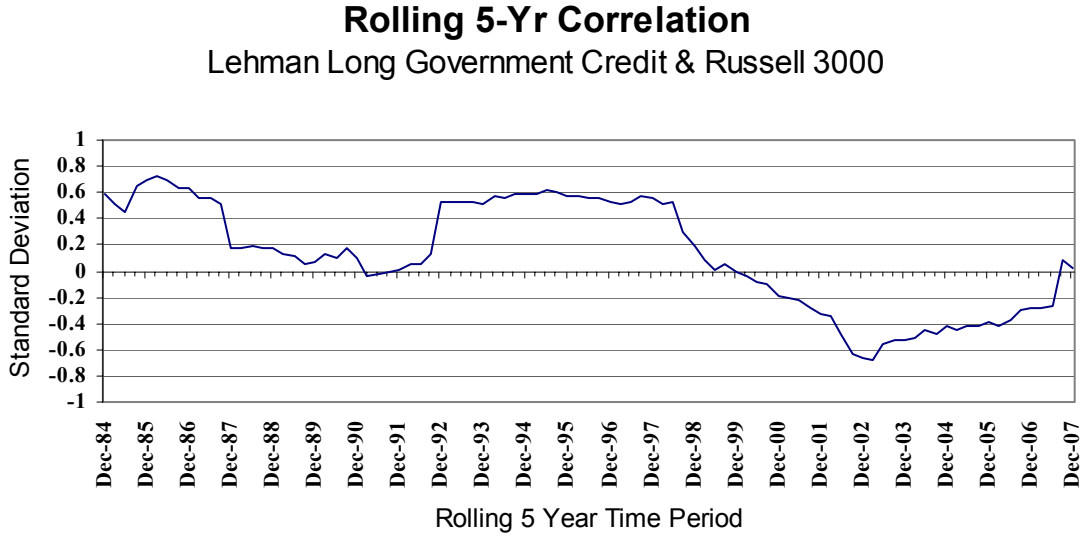
The procedure to generate correlations with liabilities involved several steps. We calculated the correlation between two asset classes over multiple rolling time periods. For example, for bonds and stocks, we had data spanning over twenty years. We then calculated a five-year correlation of the beginning of this period. This time period started with first quarter 1980 and went through fourth quarter 1984. Then the next quarter's return for stocks and bonds was added to the respective time series and the oldest quarterly return was dropped. The correlation coefficient was calculated on the stock and bond returns over this new five-year time period. This procedure was repeated through the latest five-year period covering first quarter 2003 through fourth quarter 2007. We were able to generate 93 correlations using this procedure.

We also examined the relationship between bond indices of varying duration. The liabilities are similar to a bond portfolio in their response to changes in inflation and interest rates. Thus, by supplementing the work presented below with a close examination of the relationships between bond indices of varying duration we were able to gather valuable information regarding key relationships. Specifically, the connection between the liabilities and the asset classes as well as between long-term bonds and other asset classes. In general, we found that bond portfolios of varying duration were consistently very highly correlated over time. We also found that the closer the duration of two bond portfolios are, the higher the correlation tends to be.

Bonds and Domestic Equities

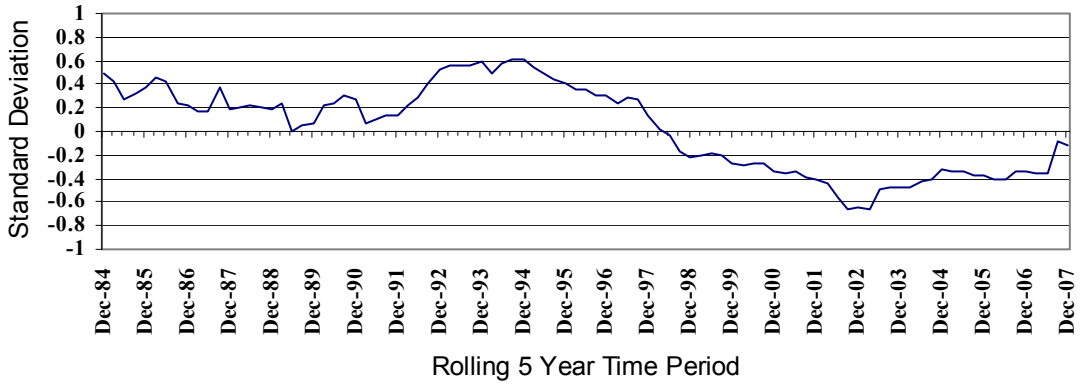
The underlying indexes used to calculate the correlations between bonds and large capitalization stocks were the Lehman Long Government/Credit Index and the Russell 3000. Rolling five-year correlations were calculated over the past twenty years.

Prior to the stock market crash in the fourth quarter of 1987, the correlation between bonds and large cap stocks tended to be between +0.40 and +0.70. Over the next 5 years, while the fourth quarter 1987 stock return is included in the calculations, the correlation between stocks and bonds falls dramatically. After the fourth quarter of 1987 stock returns are dropped from the rolling five-year data, the correlation between bonds and stocks rises to a level comparable to its previous range of +0.30 to +0.60. The correlation then dropped again beginning in 1998 and soon exceeded the previous negative levels seen in 1990-1991 until mid-2003 where it has since climbed from approximately -0.70 to +0.02 in the most recent quarter. This data suggests that the relationship between domestic bonds and stocks can vary dramatically, but is likely to be within the range of 0.00 and +0.30 when markets are in equilibrium.



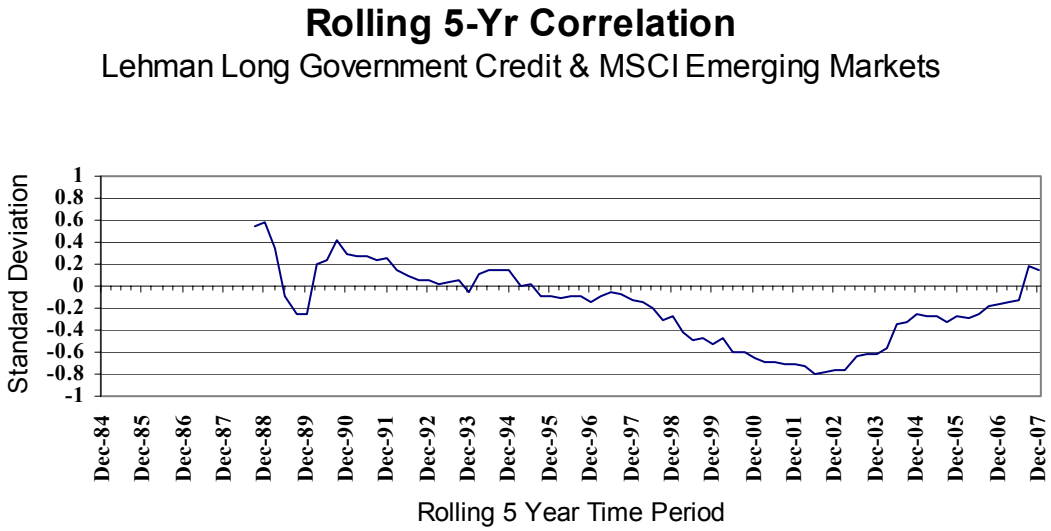
Bonds and International Equities

International equities are represented by the Morgan Stanley Capital International (MSCI), Europe, Australasia & Far East (EAFE) Index. Between 1984 and 1989, the correlation gradually fell from +0.50 to +0.07 and then climbed to the period high of just over +0.60 in 1994. Subsequently, the correlation fell over the next nine years to the period low of -0.66 in 2003; however, the correlation has since rebounded to a level just below -0.10 in the most recent quarter. It is our expectation that a correlation range between -0.10 and +0.20 is likely going forward.



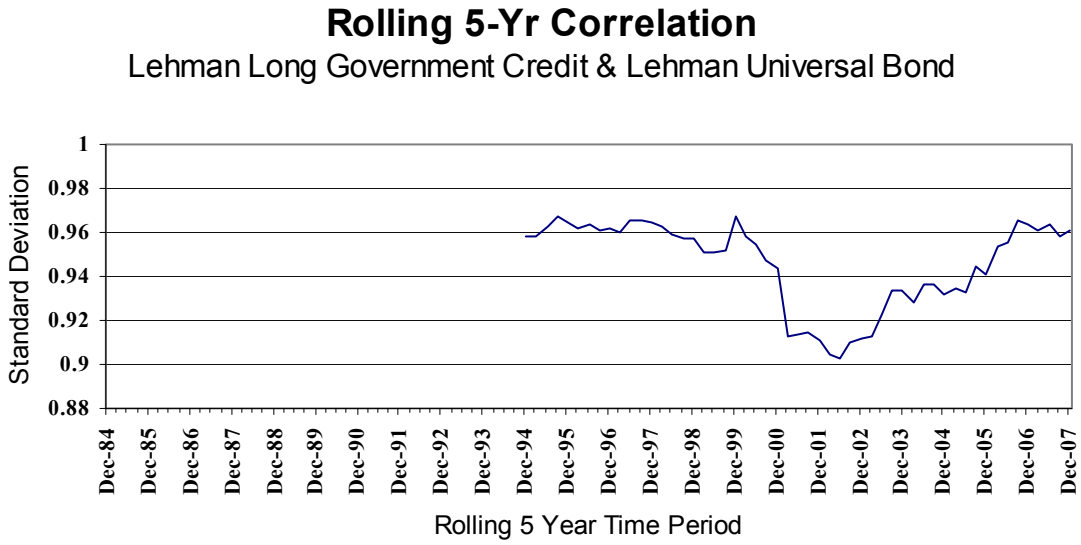
Bonds and Emerging Market Equities

Emerging market equities are represented by the Morgan Stanley Capital International Emerging Markets Index (MSCI). The earliest available data exhibits the highest correlation of approximately +0.58 in 1988. From that point and until 2002, the correlation fell gradually to -0.80. It has since climbed to approximately +0.20 in more recent quarters. It is our expectation that a correlation range between -0.20 and +0.15 is likely going forward.



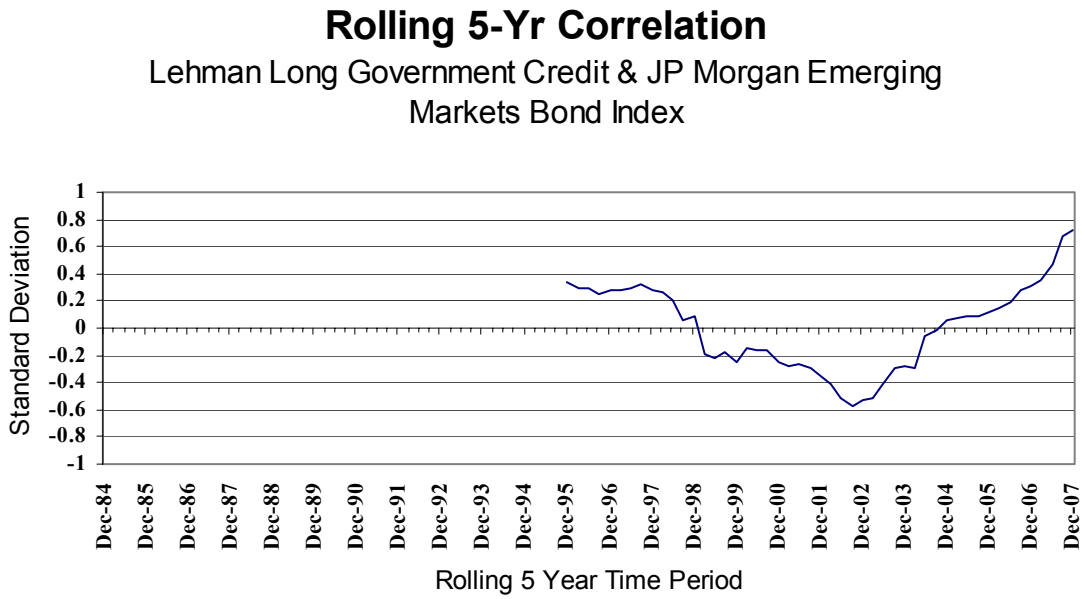
Bonds and Domestic Fixed Income

Domestic fixed income is represented by the Lehman Universal Bond Index. The correlation over the entire period is within the range of +0.90 to +0.97. Within the earlier years of 1994 to 1999, the correlation is fairly steady and hovers around +0.96. It is from early 2000 that the correlation drops dramatically to approximately +0.90 in late 2002. From that point on, the correlation has rapidly ascended +0.06 to return back to around +0.96 in late 2007. Going forward, we estimate the correlation between long bonds and core issues will be between +0.85 and +0.95.



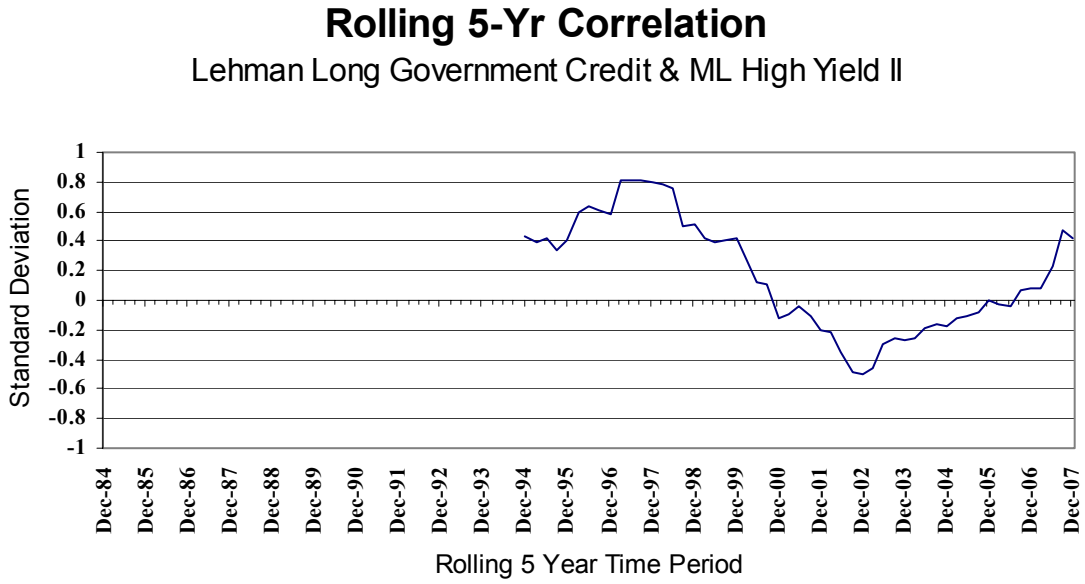
Bonds and Emerging Market Debt

Emerging market debt is represented by the JP Morgan Emerging Markets Bond Index. The five-year rolling correlation over the earliest available periods shows a decline from +0.30 in late 1994 to -0.58 in 2002. Since 2002, the correlation has been on an upward climb and has recently reached the period high of +0.70. Going forward, we estimate the correlation between long bonds and emerging market debt will be between +0.40 and +0.70.



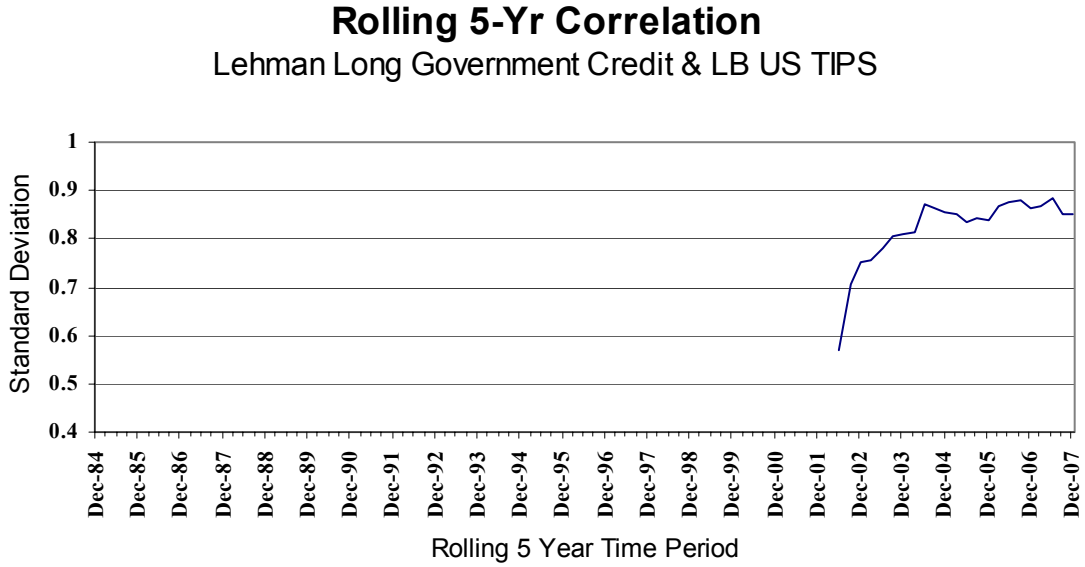
Bonds and High Yield Issues

The Index used for this analysis is the Merrill Lynch High Yield Master II Bond Index. Prior to mid-1998, the correlation over the earliest periods exhibits an increase from +0.40 to the period high of +0.80. However in late 1998, the correlation takes a dramatic decent to the period low of -0.45 in the third quarter of 2002. The correlation has since been on an upward climb returning to positive ground in the most recent quarters and is approximately +0.40. Going forward, we estimate the correlation between bonds and high yield issues will be between +0.30 and +0.50.



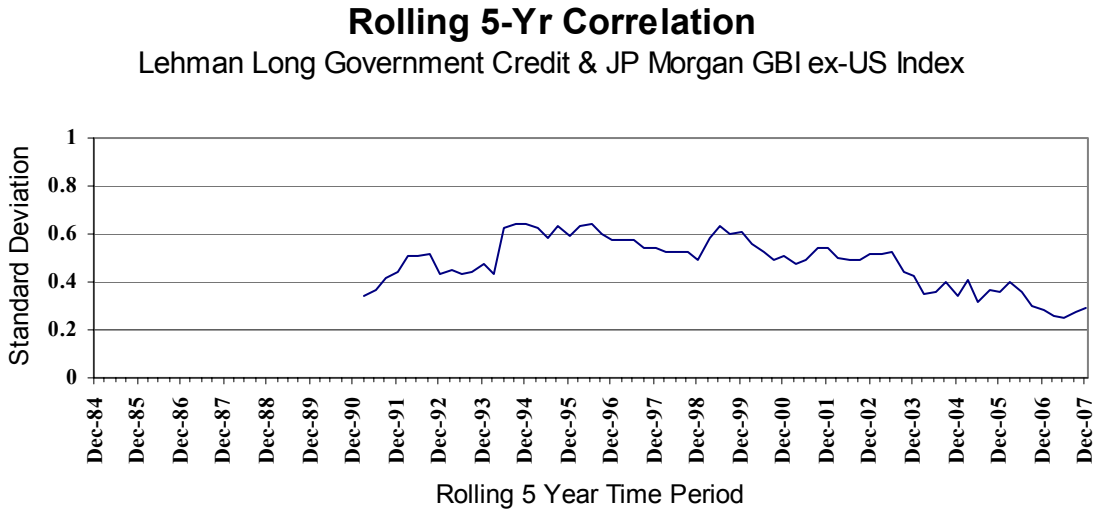
Bonds and Treasury Inflation Protected Securities

The Index used for this analysis is the Lehman US TIPS Index. The 5-year rolling correlation over the few periods observed has risen from under +0.60 to approximately +0.90 in mid-2004. From 2004 the correlation has been relatively stable, remaining in the +0.85 to +0.88 range. While the history of this asset class is quite brief, we estimate the correlation between long bonds and TIPS will be between +0.80 and +0.90 over the next five years.



Bonds and Global ex-US Fixed Income

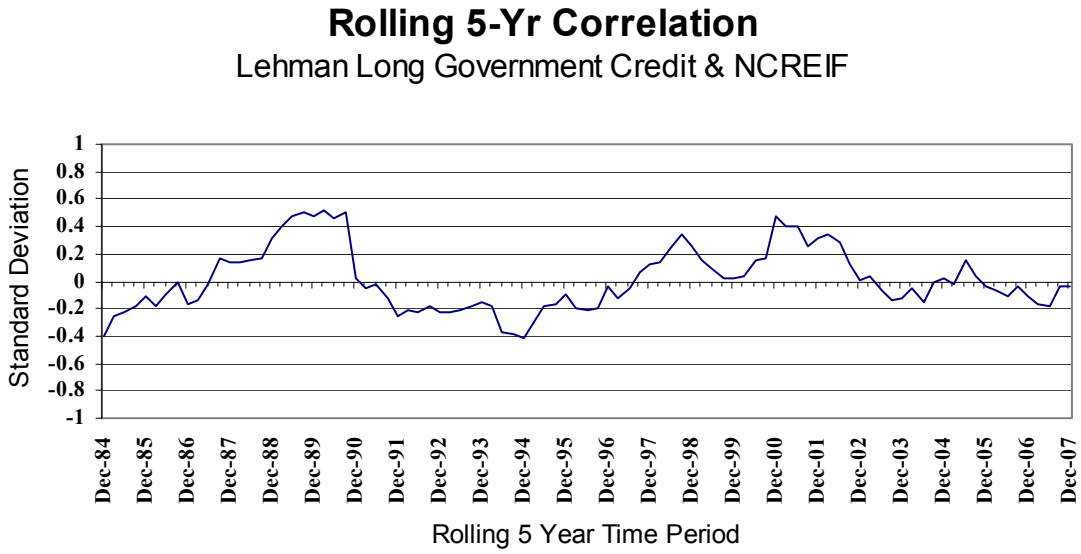
Global ex-US fixed income is represented by the JP Morgan Global Bond Index ex-US (unhedged). The 5-year rolling correlation over the periods observed was between roughly +0.40 and +0.60 over most of the history of the index. Since 1999, the correlation has fallen slightly to approximately +0.3. Going forward, we estimate the correlation between long bonds and non-US issues will increase and will range between +0.4 and +0.7.



Bonds and Private Real Estate

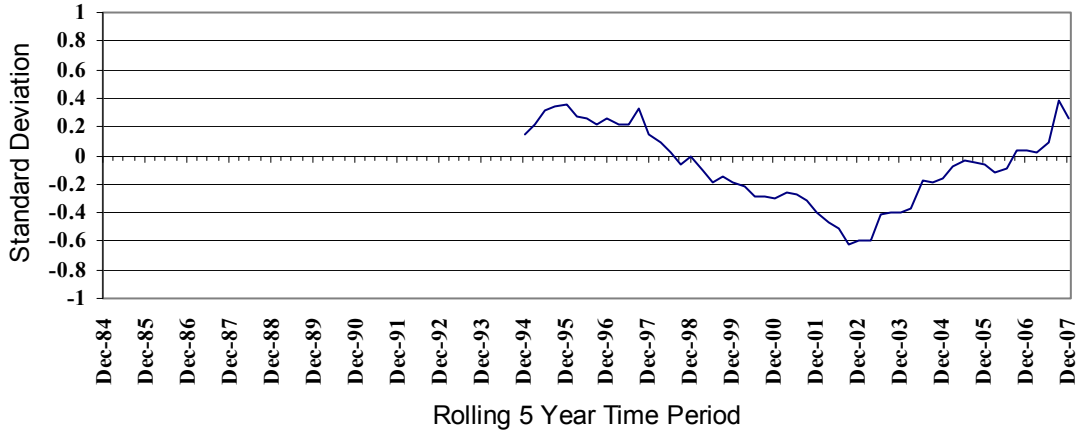
The time series used for real estate performance is the NCREIF Index. This is a nationwide index tracking institutional real estate transactions. The correlation of bonds with real estate has been volatile. In the late 1980s the correlation declined dramatically from +0.60 and by the fourth quarter of 1994, the correlation had dropped to -0.40. Subsequently, the correlation climbed and oscillated for a time between the range of +0.00 and +0.40. Since 2002, the correlation has been within the range of -0.20 and +0.20 and by the end of 2007, the correlation stood at -0.04.

Because real estate returns are comprised of income and price appreciation/depreciation components, there are certain similarities to bond returns. Real estate investments are expected to have a strong income component in the coming years, with relatively minimal price appreciation. Bond returns are also expected to be dominated by income (coupon) payments with relatively minor price appreciation. As a result of this relatively similar performance expectation, albeit with bonds yielding less than real estate, we are anticipating the correlation of bonds with real estate to be somewhat positive, ranging from 0.00 to +0.30.



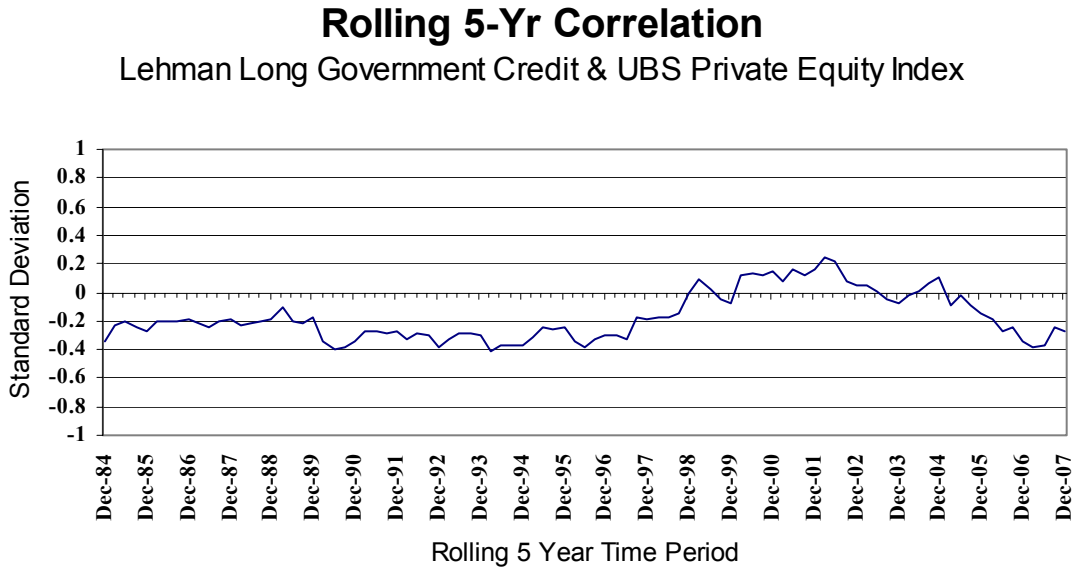
Bonds and Public Real Estate

Public real estate is represented using the FTSE EPRA/NAREIT Global Real Estate Index. The global real estate index, although limited in a historical context, explicitly exhibits the market's volatility and cyclical nature. During the earlier periods, the correlation falls from an apex of +0.36 in late 1994, to -0.60 in 2002. However from this point, it climbs to a new apex of +0.38 in mid-2007 before declining to approximately +0.25 in late 2007. Going forward, we are anticipating the correlation of bonds with global, publicly-listed real estate to be somewhat positive, ranging from 0.00 to +0.20.



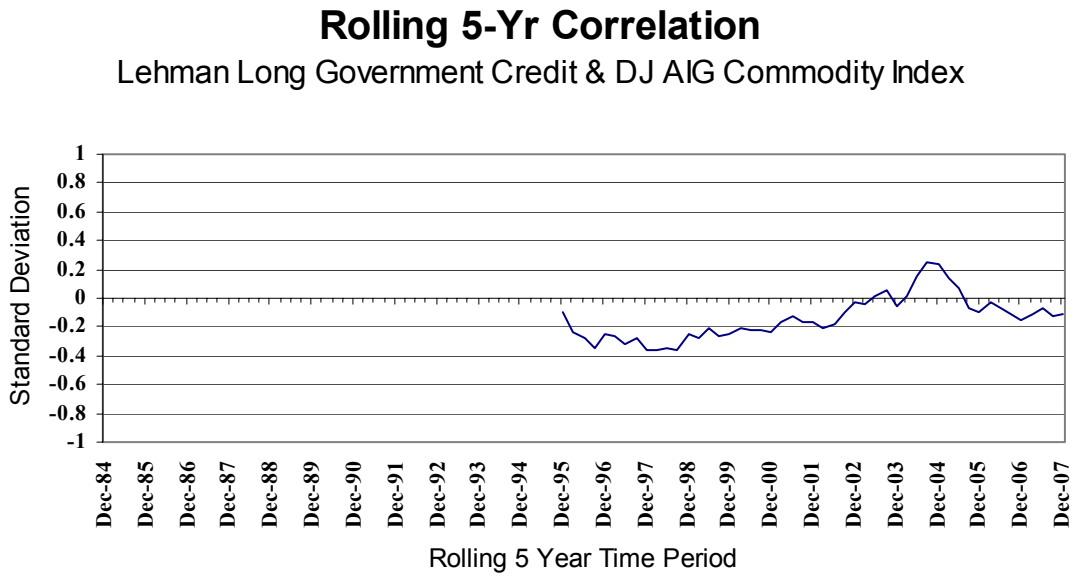
Bonds and Alternative Investments

The Index used for this analysis is the UBS Private Equity Performance Indicator which attempts to capture representative returns associated with the private equity and alternative investment market. The 5-year rolling correlation over the periods observed started out fairly stable at around -0.20. In 1990 it dropped to -0.40 and remained close to this level through 1995. The correlation then gradually climbs to +0.24 in 2002 before falling and ending 2003 at just above -0.10. During the most recent years, the correlation falls to approximately -0.30 in the fourth quarter of 2007. Going forward, it is our estimate that the correlation between domestic long bonds and private equity investments will be between -0.20 and +0.20.



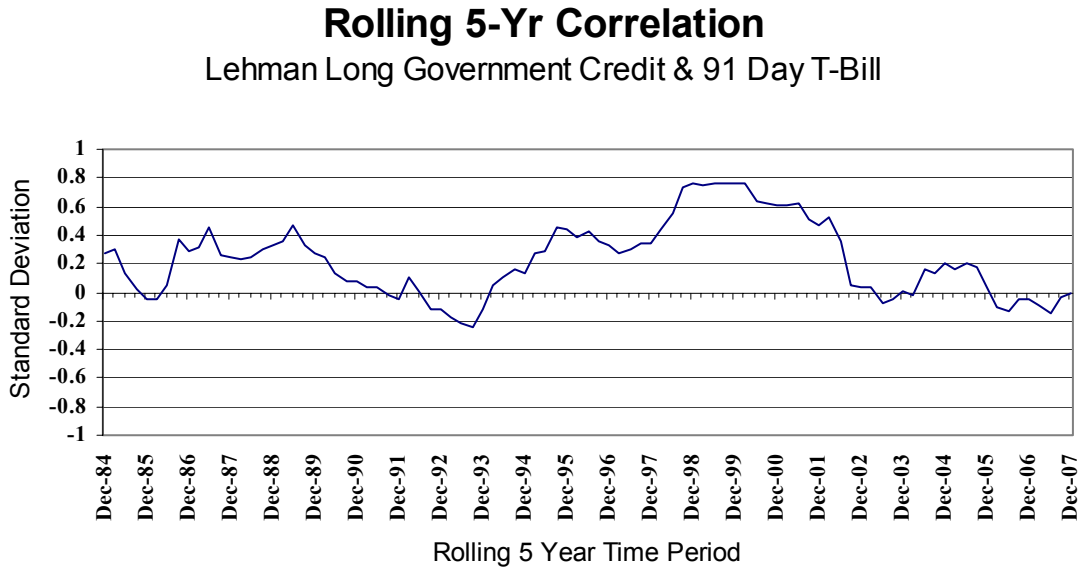
Bonds and Commodities

The 5-year rolling correlation over the periods observed has ranged between 0.00 and -0.40 over most time periods. The correlation gradually climbs to over +0.20 through 2004 and then declines over the remainder of the period to settle at approximately -0.10. Going forward, it is our estimate that the correlation between domestic long bonds and futures-based commodity investments will be between -0.30 and +0.10.



Bonds and 91-Day Treasury Bills

Until recently, bonds and 91-day Treasury Bills have historically been relatively uncorrelated. However, in 1996 the correlation began to rise gradually and leveled off at approximately +0.70 from fourth quarter 1998 through mid-2000. After this period, the correlation fell sharply over the next three years before rising again briefly to +0.20 through mid-2005 when the correlations fell to just below 0.00 in 2007. We expect that the correlation between bonds and Treasury bills is likely to be between +0.10 and +0.40 over the next three to five years.



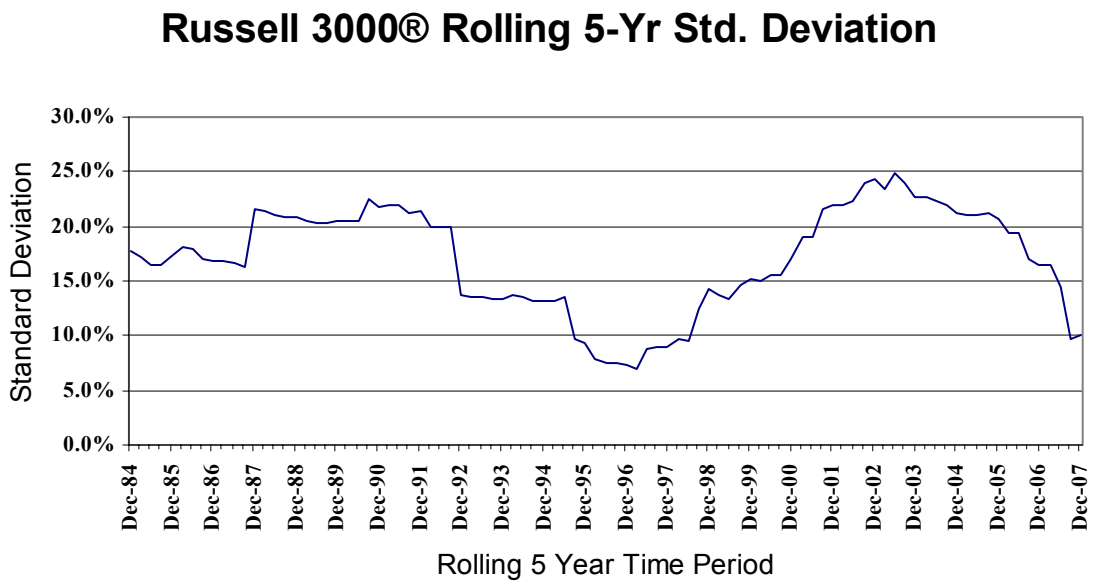
APPENDIX C – ASSET CLASS RISK

Due to more volatile correlations between the asset classes, we felt it was appropriate to review the historical levels of volatility as well. We calculated the risk of each asset class, as represented by the standard deviation, using the same rolling five-year methodology that was used for calculating the correlation coefficients. If possible, we calculated the rolling standard deviation of each asset class over the last twenty-year period. For example, for large/mid cap stocks, the first time period for the rolling five-year risk started with first quarter 1980 through fourth quarter 1984. Then the next quarter's return for stocks was added to the respective time series and the oldest quarterly return was dropped. The standard deviation of the returns of the asset class was calculated over this new five-year time period. This procedure was repeated through the latest five-year period covering first quarter 2000 through the fourth quarter 2004. We were able to generate 93 standard deviations using this procedure. The results and our future expectations are listed on the following pages.

Domestic Equities

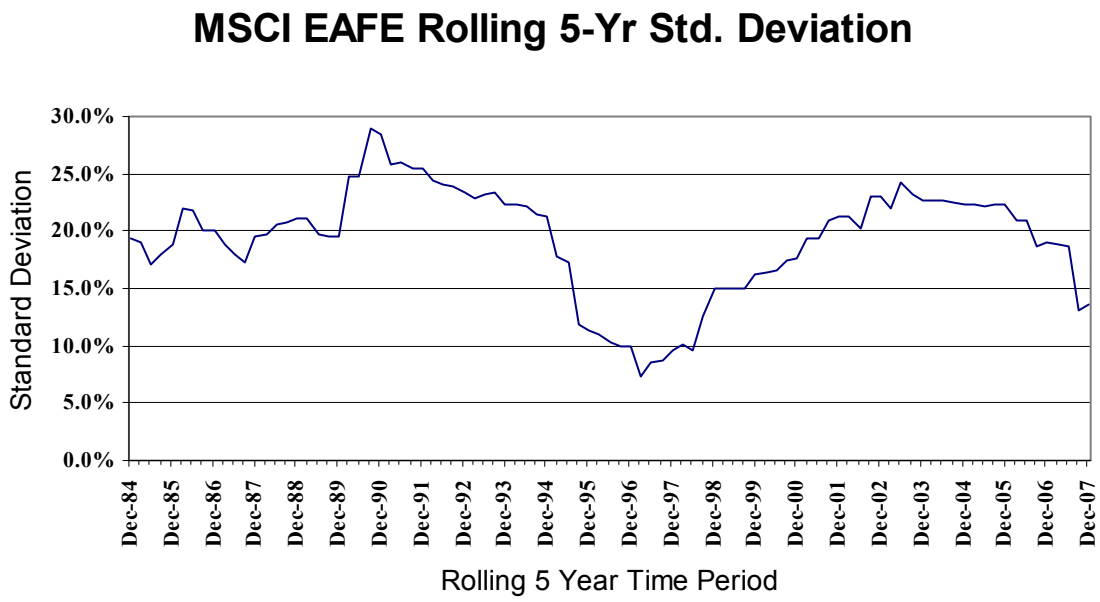
The underlying index used to calculate the standard deviation of domestic stocks was the Russell 3000. Rolling five-year standard deviations were calculated for as long as the data was available.

Prior to the stock market crash in the fourth quarter of 1987, the standard deviation of large/mid cap stocks tended to center around 15%. Over the next 4 years, while the fourth quarter 1987 stock return is included in the calculations, the standard deviation rises to between 20% and 23%. After the fourth quarter of 1987 stock return is dropped from the rolling four-year data, the risk level drops and remains below 15% throughout most of the 1990's. However, starting in 1997 there is an upward trend, with the risk level at approximately 25% in 2003. Since 2003, the standard deviation falls to an ending risk level of 10% in 2007. We expect the risk to be between 17% and 23% over the next five years.



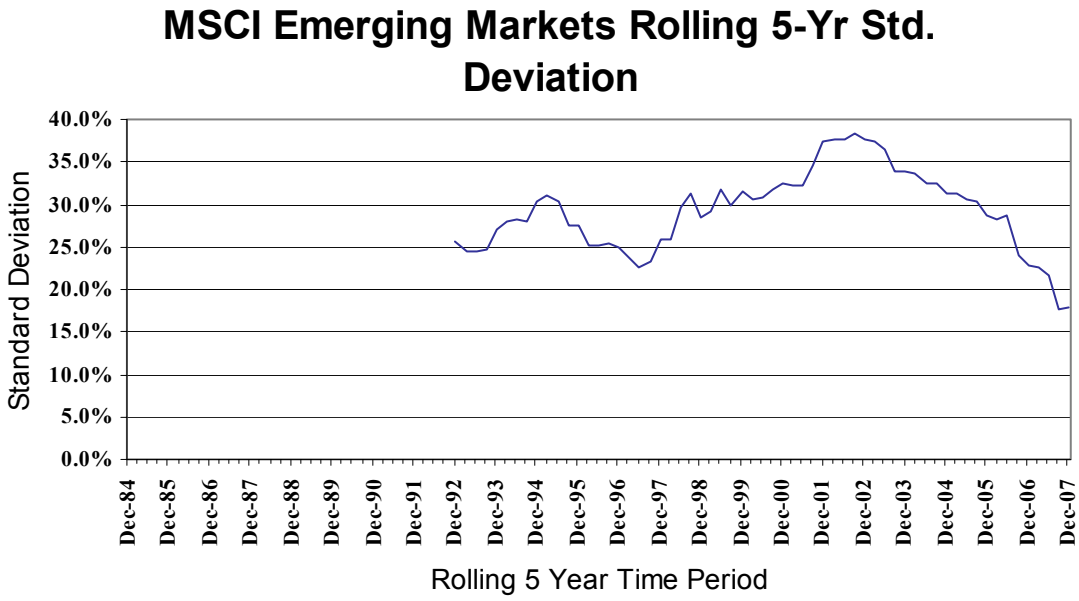
International Equities

International equities are represented by the Morgan Stanley Capital International (MSCI), Europe, Australia & Far East (EAFE) Index. From 1984 through 1993, the rolling standard deviation was generally between 17% and 25%. There was a pronounced downward trend from 1993 through mid-1997, when it reached a low of 6%. Between mid-1997 and early 2003, the standard deviation rose to 24%. Since 2003, the risk level has gradually fallen to 12%. It is our expectation that the international equity risk level will range between 19% and 23% going forward.



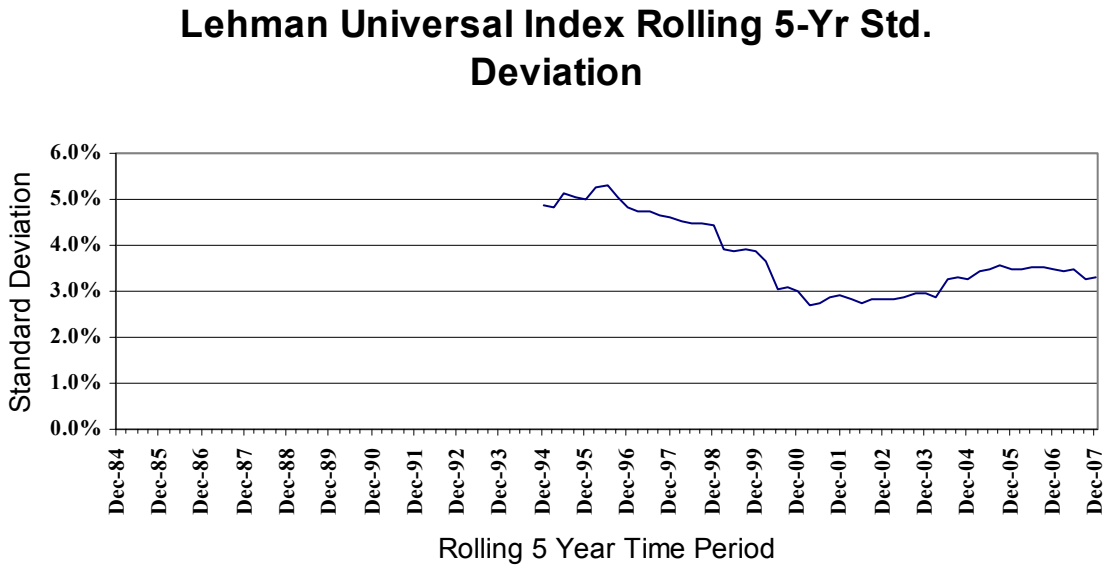
Emerging Market Equities

International equities are represented by the Morgan Stanley Capital International (MSCI), Emerging Market Index. From 1992 through mid-2003, the rolling standard deviation was generally between 25% and 35%. After an initial upward swing through early 1995, there was a downward trend in the standard deviation and it fell to 23% in 1997. From mid-1997, the risk level increased for 5 years to reach a period high of 37%. Since 2003, the standard deviation has fallen sharply to the period low of 18%. It is our expectation that the international equity risk level will range between 22% and 30% going forward.



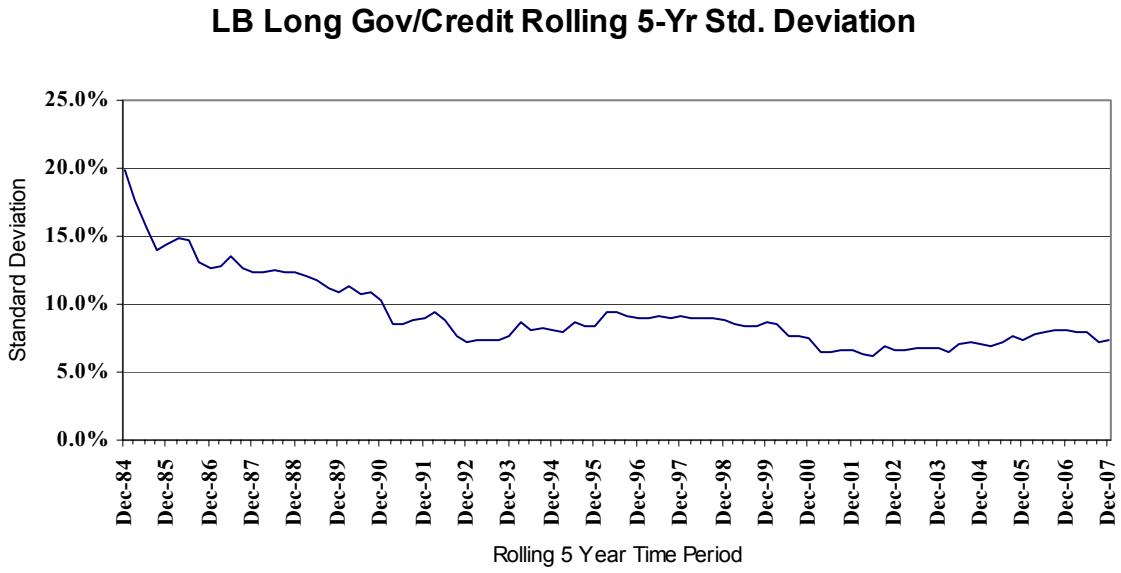
Domestic Fixed Income

The standard deviation of domestic bonds, as represented by the Lehman Universal Bond Index, has ranged between 3% and 5% over most of the observed time periods. The standard deviation gradually fell from the period high of over 5% in 1994 to the period low of just under 3% in 2001. The risk remained under 3% until 2004 when it began its ascent to 3.5% in 2005 before gently declining to just over 3% in 2007. However, we believe that a standard deviation of between 5 and 8% to be likely going forward.



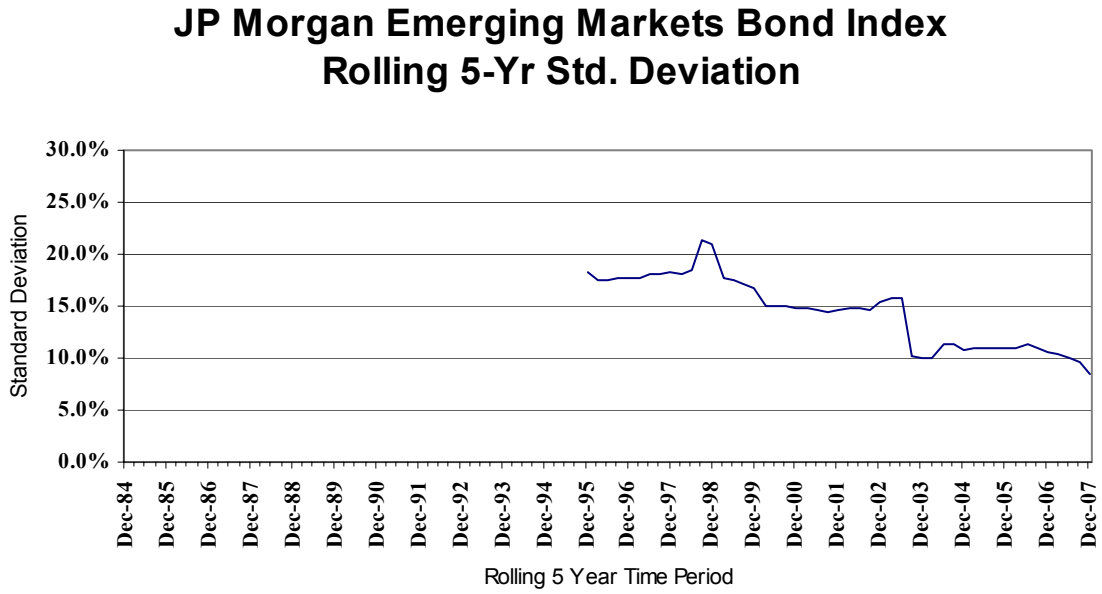
Long-Duration Fixed Income

The standard deviation of high yield bonds, as measured by the Lehman Long Government/Credit Index, has been between 5% and 20% since 1984. The standard deviation has remained relatively stable and within the 5% to 10% range since the third quarter of 1990, ending 2007 at roughly 7%. We believe that a standard deviation of between 7 and 11% is likely going forward.



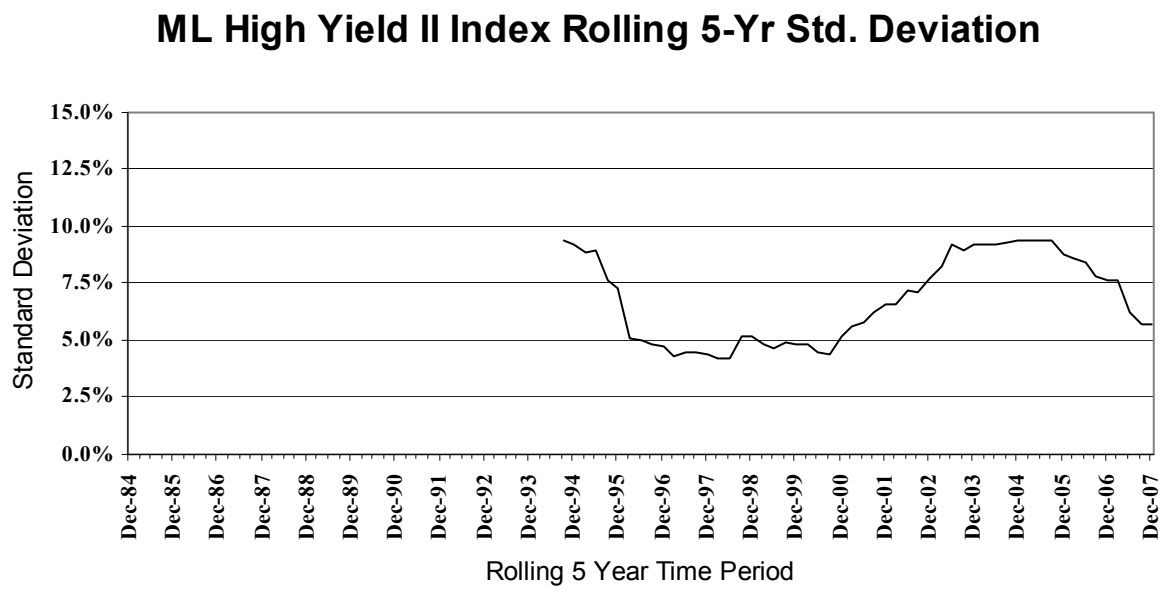
Emerging Market Debt

The standard deviation of emerging market debt, as measured by JP Morgan Emerging Markets Index, has been primarily between 10% and 20% since 1994. The most rapid drop occurred in early to mid-2003, when the standard deviation fell 5% and it had remained at around 10% until late 2007 when it fell to the period low of 8%. We believe that a standard deviation of between 9 and 13% is likely going forward.



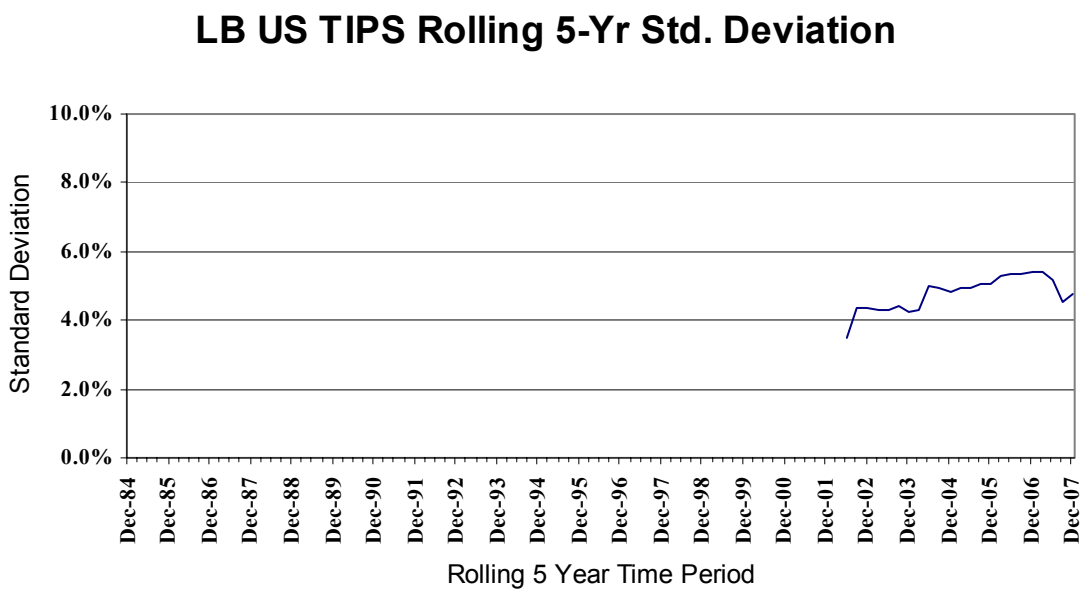
Domestic High Yield Fixed Income

The standard deviation of domestic high yield fixed income, as measured by the Merrill Lynch High Yield II Index, has ranged between 5 and 10% since the earliest available rolling period. The standard deviation fell initially from 9% in early 1995 to 5% in 1996 before remaining relatively constant for the following 4 years. In early 2001, the risk level rapidly increased to approximately the same level it was in the earliest available period and remained at around 9% until it started tapering off in 2005 to end at 6% in late 2007. We believe that a standard deviation of between 6 and 10% is likely going forward.



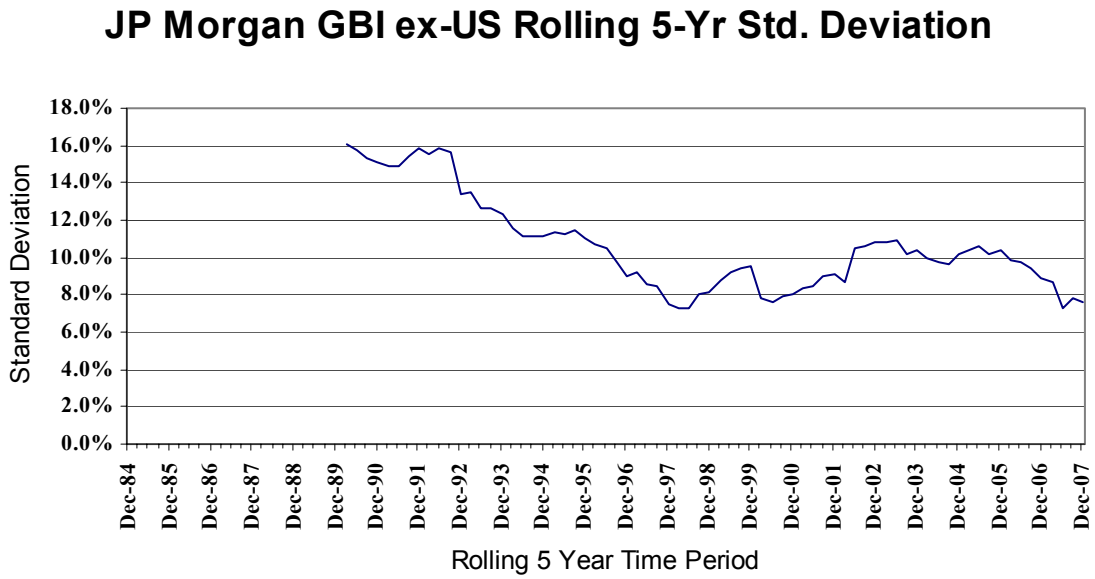
Treasury Inflation Protected Securities

The standard deviation of TIPS, as measured by the Lehman TIPS Index, has ranged between 4% and 6% since 2001. We believe that a standard deviation of between 3 and 6% is likely going forward.



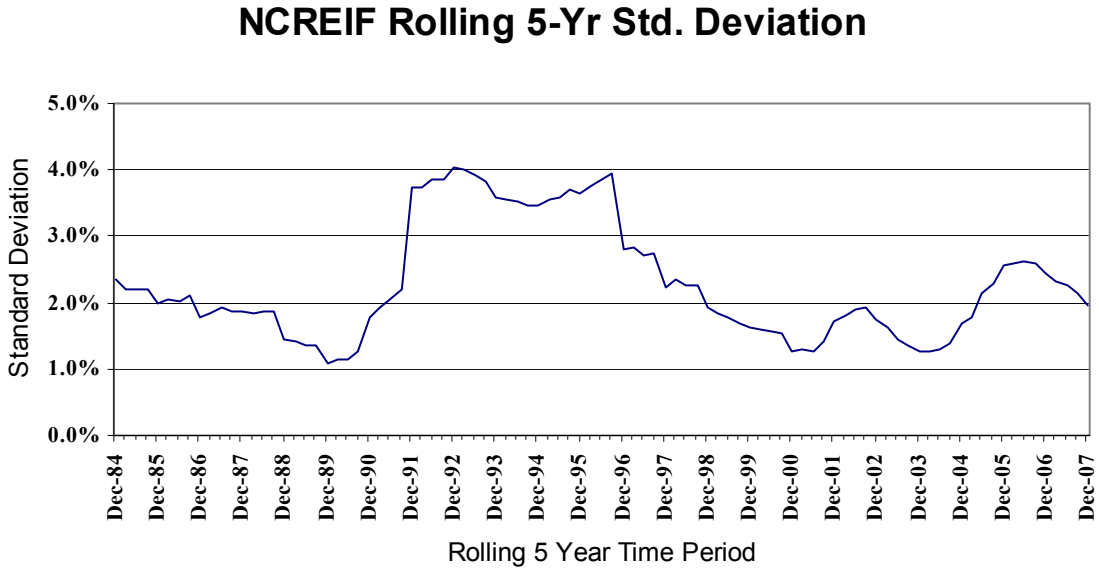
Global ex-US Fixed Income (Unhedged)

The standard deviation of global ex-US fixed income (unhedged), as measured by the JP Morgan Global Bond Index ex-US (unhedged), has ranged from 7% to 16% since 1990. The standard deviation remained above 8% between 2001 and late 2006, after which it fell to end at approximately 7.5% in late 2007. We believe that a standard deviation between 6 and 10% is likely going forward.



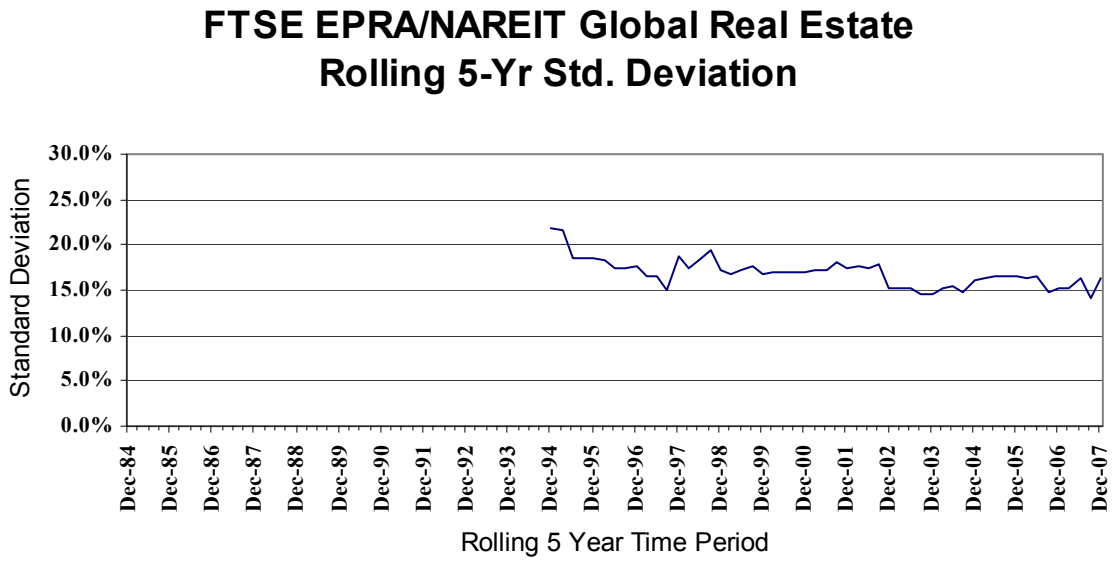
Private Real Estate

The standard deviation of private real estate investments, as measured by the NCREIF Index, has been between approximately 1% and 3% for the majority of periods since 1984. However, for the 5 year period 1991 to 1996 the standard deviation was in its highest range between 3% and 4%. As this data reflects the smoothing associated with transaction-based accounting, it significantly underestimates the true volatility of private real estate. We believe that a standard deviation of 10 - 14% is likely going forward.



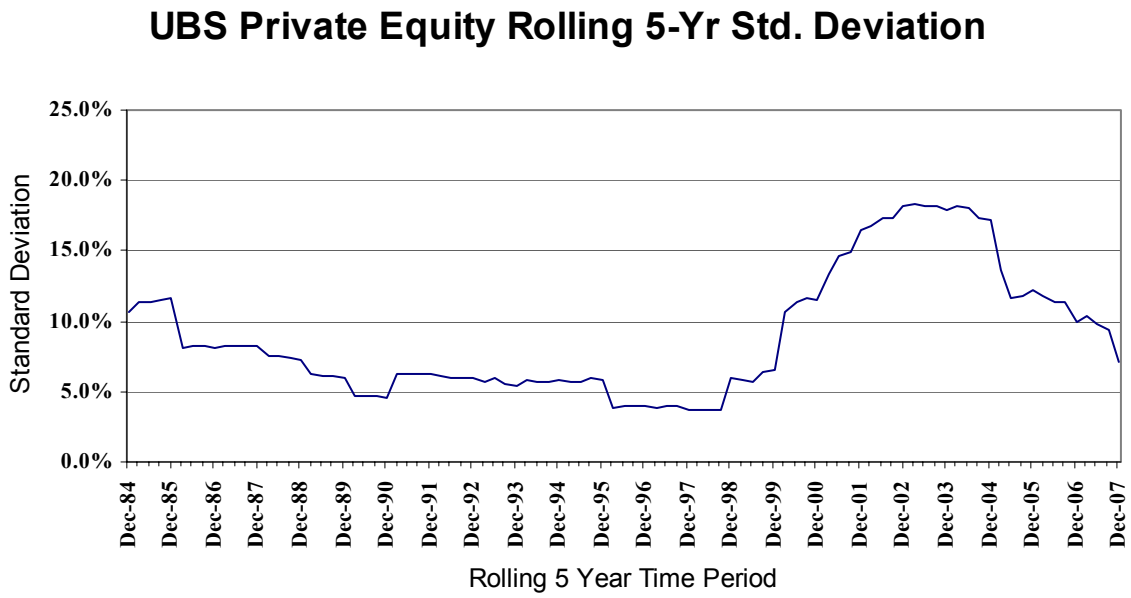
Public Real Estate

The standard deviation of public real estate investments, as measured by the FTSE EPRA/NAREIT Global Real Estate Index, has remained between 15% and 20% for most periods since 1994. The standard deviation has gradually fallen from the period high of 22% in 1994 to rest just above 15% in late 2007. We believe that a standard deviation of 12-18% is likely going forward.



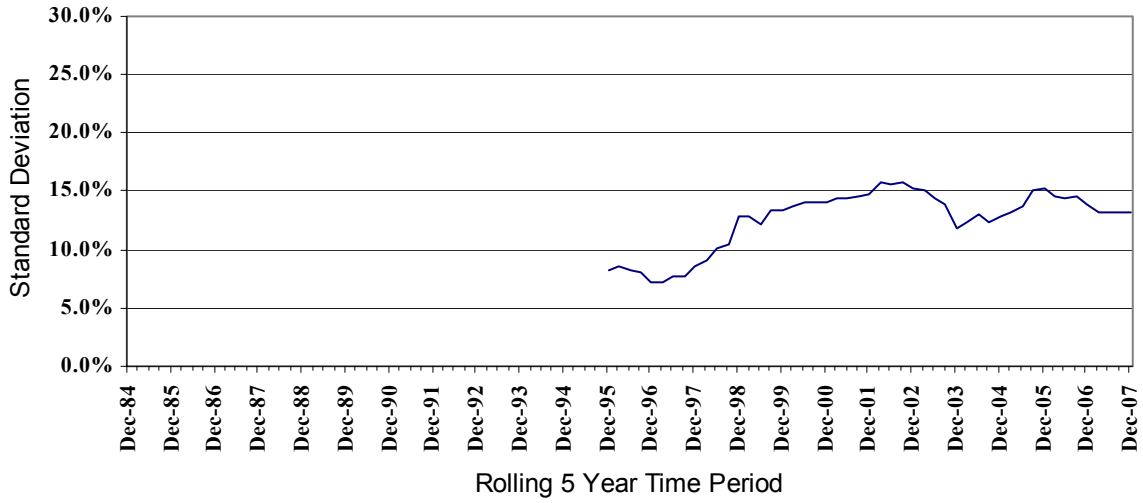
Alternative Investments

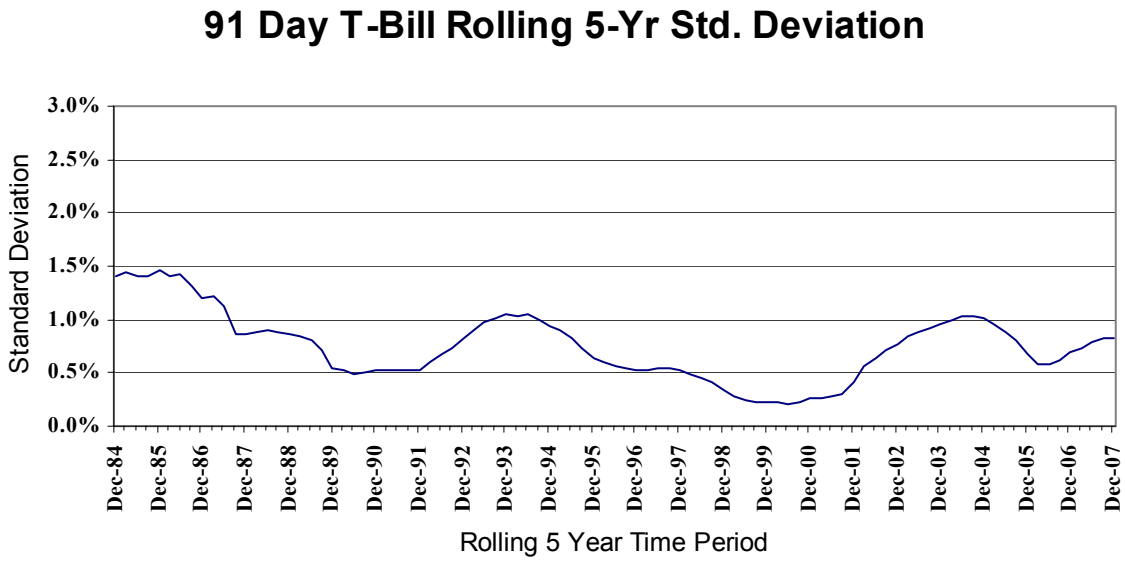
The Index used for this analysis is the UBS Private Equity Index. As shown below, the rolling 5-year risk associated with this index is relatively low (between 5% and 10% for most time periods) for periods through 1999. The risk level rose sharply to 18% through the fourth quarter of 2004, before dramatically falling to 7% in the fourth quarter of 2007. Although the volatility of the index over the long-term is relatively low, we believe a risk premium needs to be added to this asset class to compensate for the lack of liquidity and the short-term volatility associated with the different strategies and biases of the respective funds. In the short-term, the potential difficulty of liquidating private equity assets could prove to be significant and possibly result in selling assets at a material loss. As such, we believe it is prudent to assume a conservative stance and project a volatility number that fully captures the liquidity risk and short-term volatility potential within this asset class. Consequently, we believe a projected risk level of 30% is prudent for private equity.



Commodities

The 5-year standard deviation of the DJ AIG Commodity Index is used to depict the risk associated with commodities. As shown below, the rolling 5-year standard deviation associated with this index has ranged from a low of approximately 7% in 1997 to a high of nearly 16% in early 2002. The volatility of this index, and this sector, is closely tied to the inflation and interest rates. Consequently, we believe a projected risk level between 14 and 18% is prudent for commodities.



91-Day Treasury Bills

The risk of T-Bills, as measured by standard deviation, has been primarily in the 0.5% to 1.0% range. During the earliest rolling periods, the standard deviation was at the period high of 1.4% before falling to 0.5% in late 1989. Since 1991 the risk has oscillated either side of 0.5%, falling as low as 0.21% in mid-2000 before climbing to approximately 0.8% in late 2007. We expect the risk to rise somewhat and be between 1 and 2%.